DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

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HEARINGS

BEFORE THE

JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

EIGHTY-FOURTH CONGRESS

SECOND SESSION

ON

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

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DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

TUESDAY, FEBRUARY 7, 1956

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 10 a. m., pursuant to notice, in the caucus room of the House Office Building, Senator Clinton P. Anderson (chairman of the Joint Committee) presiding.

Present: Senators Anderson and Pastore, and Representatives Durham, Price, Cole, Kilday, and Van Zandt.

Present also: George Norris, Jr., and Wayne P. Brobeck of the committee staff.

Chairman ANDERSON. The Joint Committee will be in order.

I am very happy to again start the hearings which are held under section 202 of the Atomic Energy Act. Last year we had a sort of collateral issue which embraced a good deal of the time of our committee and of the Commission. This year we hope to have no collateral issues which will take our time, and one particular issue which has been barred by unanimous consent.

We, therefore, are very happy to welcome the members of the Atomic Energy Commission here today to testify. I note the absence of Dr. Von Neumann who is not well. It was the privilege of this committee to send him a letter expressing our deep regret at his illness, and our very sincere hope for an early recovery, and I am sure that is the wish not only of the Joint Committee on Atomic Energy but of good citizens in America everywhere.

I think without any further preliminaries, I will ask Admiral Strauss, the Chairman of the Commission, to begin the testimony of the Atomic Energy Commission. Let me say that we are very pleased that the Atomic Energy Commission has furnished us copies so that we may have a chance to examine them, and we will be happy to take each individual paper as you desire. If you would like to complete a statement, we will permit you to do so.

We prefer to have a chance to question as we go along, but we are not insistent upon it. I do hope to cover a good deal of ground in this hearing this year. Admiral Strauss.

STATEMENTS OF LEWIS L. STRAUSS, CHAIRMAN OF THE ATOMIC ENERGY COMMISSION; DR. W. F. LIBBY, MEMBER; HAROLD VANCE, MEMBER; K. E. FIELDS, GENERAL MANAGER OF THE COMMISSION; WILLIAM MITCHELL, GENERAL COUNSEL OF THE COMMISSION; DR. KENNETH DAVIS, DIRECTOR OF THE DIVISION OF REACTOR DEVELOPMENT; AND HAROLD L. PRICE, DIRECTOR, DIVISION OF CIVILIAN APPLICATION

Mr. STRAUSS. Thank you, Mr. Chairman. Of course, we will be amenable to any procedure that you require, I would like to say that it is a privilege and it is a very genuine privilege to participate in these hearings called by your committee pursuant to section 202 of the Atomic Energy Act of 1954. While this is the first opportunity we have had to meet with you as a committee since July 28, 1955, we did meet with you as a group of friends and individuals in Geneva, and I would like to report that in the interval we have addressed to you over 370 communications in the form of letters or reports designed to discharge our statutory function to keep the committee fully and currently informed. I think that is an impressive number, and I hope that the committee has found those reports and letters informative.

I intend to make only a few introductory remarks this morning, after which the Commission is ready to present prepared materials on various topics, related to the development, growth, and state of the atomic energy industry.

Before doing so, it would be appropriate to refer to the report of the Panel on the Impact of the Peaceful Uses of Atomic Energy, that is, the McKinney panel, appointed by the Joint Committee. The willingness of men of the caliber of the members of that panel to undertake such a broad and difficult assignment was encouraging. The Commission cooperated fully with the panel. We are giving careful study and consideration to the report and we are sure that it will be of great assistance in charting a true course toward achieving the benefits of the peaceful applications of atomic energy.

On January 31, 1955, when the Commission reported to your committee on its activities during the initial 5-month period of the 1954 act, I stated that the foundations on which American industry would participate in the use of atomic energy were even then well advanced and that, as of that date, a substantial portion of industry was in a position to take part in the peaceful development of atomic energy. During the year just concluded these foundations not only have been broadened, but upon them a structure is being built which we believe offers American industry a maximum opportunity to participate in development of the atom for public good.

The entire program of industrial participation, as developed and expanded by the Commission, has as its broad purpose the hastening of the day when the American people, and those of cooperating nations, may enjoy the manifold benefits of this new source of energy.

The Commission's program is directed toward encouraging development of the uses of atomic energy in the framework of the American free enterprise system, thereby deriving profit from the initiative and competitive resourcefulness which is characteristic of that system.

However, it is recognized that the technology necessary to support widespread industrial uses of nuclear energy must continue to be developed. We believe that this will best be achieved, and most rapidly, through close cooperation of Government and industry. Therefore, it is the Commission's policy and purpose to pursue, at its laboratories and installations, its work on the research and development of peaceful applications, as for example, the further development of various concepts of atomic reactors designed for the production of power. In this way, the Commission can serve to accelerate the actual commercial applications and use of atomic energy for peaceful purposes. The Commission also is prepared to maintain various services and facilities, such as facilities for enrichment of uranium, which are necessary in the creation and maintenance of an atomic energy industry but which, at the present time, cannot be undertaken by industry itself for economic reasons. On the other hand, as will be pointed out in this testimony, the Commission is encouraging private enterprise to furnish services and supplies both to AEC and the new atomic energy industry.

Substantial progress was achieved during 1955 in all facets of the program to encourage and aid private enterprise in the development of peaceful uses of atomic energy at home and abroad, and to provide the necessary regulations and licensing procedures called for in the act of 1954. Proposed regulations have been published in the Federal Register for public comment and the regulations themselves are currently being issued as rapidly as completed.

The fact that the Commission is receiving a constant flow of applications for access permits from a wide and comprehensive cross-section of industries, trades, and professions is in itself testimony to the interest of private organizations, public groups and individuals in obtaining access to restricted data on peacetime uses of atomic energy. An accelerated program of reviewing Commission reports and other papers useful in peacetime applications and declassifying or downgrading whatever possible has been underway for some time. The companion program for publishing material available to industries and individuals in the civilian application program has been greatly accelerated. Seminars and other meetings have been held with representatives of companies interested in getting into the processing or production of selected atomic energy materials.

The power demonstration reactor program which was started a year ago is based on the belief that competitive economic nuclear power—that is to say, nuclear power which could compete with that produced from conventional fuels—would be most quickly achieved by construction and operation of full-scale plants by industry itself. The Commission recognized that the first such plants would not be economic and that Government assistance would therefore often be necessary to encourage industry's participation, and thereby, to advance the technology of nuclear power.

Despite the provision for Government assistance, however, the Commission was confident that in some instances private industry would respond by undertaking to build fullscale powerplants, without such assistance. Events have shown the validity of this belief. Two such applications to construct full-scale powerplants entirely without Government financial assistance already have been received, one from the Commonwealth Edison Co., the other from Consolidated Edison Co.

The Pennsylvania Power & Light Co. has indicated its intention to proceed in the same manner.

The responses to the Commission's first-round invitations under the power demonstration reactor program were all for large-scale power reactors, of 75,000 electrical kilowatts output or more. However, because of the intense interest evident in nunclear power for rural and remote highcost power areas, and because of the importance of small-scale power reactors to the international atoms for peace program, the Commission took steps to encourage the development and construction of civilian reactors of smaller output. On last September 21 we issued invitations for a second round of proposals, limited to reactors in the range of 5,000 to 40,000 kilowatts output. Somewhat more liberal conditions of Government financial assistance were established for the second-round proposals, due to the fact that smaller scale plants are less likely to prove economically competitive than large-scale ones. Proposals under the second-round invitation are presently being studied by the Commission.

The first full-scale atomic powerplant to be built in the United States is expected to come into operation during 1957 at Shippingport, Pa. It is not expected to be an economically competitive plant; nevertheless we—and American industry—will learn how to proceed to build other plants at much lower cost. The Duquesne Light Co. of Pittsburgh is, as you know, the sponsor of this pioneer enterprise.

Besides the Shippingport plant six other full-scale atomic powerplants, are now planned to come into operation in the United States during the next 6 or 7 years, five by private industry and one by public power groups. These seven projected plants have a total capacity of more than 840,000 kilowatts, and will be financed largely by non-Government money. They include the five major types of reactors toward which Commission research and development has been directed.

It should be added here that the Commission is conducting research and development on other reactor concepts, and has not fixed its planning or hopes on any one particular type. Research and development is underway on three concepts of power reactors besides the original five. Experimental types of all of the latter, including the Shippingport reactor, are presently under construction. Three are scheduled to be completed this year, one in 1957, and one in 1958. The power reactor program will be described in subsequent testimony in as much detail as you desire.

Acknowledgment should be made at this point of the close and efficient cooperation between the Commission and the armed services, not alone in the development, production and testing of nuclear weapons, but in advancing the art of the peaceful applications of atomic energy, and particularly in the technology of power reactors by means of such projects as the Army package power reactor, the Navy's reactor program and the aircraft reactor program of the Air Force. These projects are making significant contributions to the technology and development of power reactors.

I turn now, Mr. Chairman, to specific means by which the Commission is encouraging industry to participate in the development and use of the peaceful atom for the public good, and the Commission regulations which facilitate such participation.

A large volume of the information of use to industry in developing the peaceful uses of atomic energy is unclassified and is freely available to everyone. A very large amouant of such unclassified data has been placed in the public domain, since passage of the Atomic Energy Act of 1954.

However, the Commission has a second responsibility under the act. It cannot publish information unless it can determine that no undue risk to the common defense and security will be incurred. In making such determinations the Commission must always bear in mind the paramount objective of the act—making the maximum contribution to the common defense and security.

Certain information, necessary to industrial atomic energy development, at the same time involves the national defense and security; therefore, to encourage an atomic energy industry, it has been necessary for us to find ways to make that information available to applicants under prudent security safeguards. I am happy to be able to report that the Commission has received gratifying cooperation from industry in its solution of this problem, in accordance with the new provisions of the 1954 act. The declassification of information useful to industry has been liberalized and expedited. A substantial amount of data, previously classified as secret restricted data has been lowered in classification to confidential restricted data, thus making it more readily available to industry under the system of access permits.

Complete details of the manner in which the increasingly larger volume of technical data, bearing on the development of the peaceful uses of atomic energy, is being made available to industry will be presented to you in subsequent testimony, and I believe you will find it impressive. At this time I should like to sketch only briefly what has occurred since the Commission—early in 1955—adopted its new and amended Declassification Guide with the more liberal provisions made possible by the 1954 act. The result has been that we have been able to declassify and issue a much larger volume of information than previously.

An outstanding example of its value was the use of the new guide in reviewing the United States technical papers and exhibits for the International Conference on the Peaceful Uses of Atomic Energy at Geneva, last August. The Declassification Guide was not revised or liberalized for the purpose of the Geneva Conference. It was a consequence of the new Atomic Energy Act and had been in use, before the writing of the Geneva papers and the organization of the Geneva exhibits were started. Nevertheless, the new guide enabled our country to present a program of papers and exhibits which, both in content and scope, brought credit to the United States for its contribution to the most significant scientific and engineering conference ever assembled.

In the same manner, the new rules of declassification have been and will be, in ever-increasing proportions, of advantage in furthering the peaceful applications of atomic energy. For some time, a large staff of technical experts—drawn from AEC laboratories and installations—have been engaged in a major review program at Oak Ridge, using the new guide. This program involves no less of an undertaking than reviewing all the accumulated secret and confidential papers from past years which may be of use to industry—a total of more

than 20,000 items. That was a really Herculean undertaking. This project is now in its final stage; it is expected to be completed this month.

As of February 2, the technical reviewing group had examined some 25,000 reports. Of these more than a third had been declassified entirely. A fourth were downgraded from secret to confidential, and the remainder retained their original secret or confidential classification because of the requirements of national defense and security.

When the review project is completed, all but a small amount of information bearing on the peaceful uses of atomic energy will be ready to be made available to responsible industrial groups and individuals.

Inasmuch as the members of your committee are familiar with the two categories of access permits—one to confidential restricted data requiring a limited personnel security clearance known as an L clearance, and the other providing access to certain secret restricted data and requiring a complete background investigation and Q clearance—I will not further discuss their mechanism.

As of December 31, 1955, the Commission had received 686 applications for access permits, of which 602 had been approved as of that date. The remainder were under consideration. New applications are coming in at the rate of about 60 to 70 a month, and they represent a wide cross-section of the industries having a potential role in the field of atomic energy.

Another step, in setting up an atomic energy industry under the act of 1954 is the licensing and regulation of that industry.

This involved the creation of precedents and we have proceeded with caution. The industry for which a comprehensive system of regulation must be developed is still in its infancy. Little or no experience exists in many significant areas. In such circumstances, the Commission has refrained from setting up rigid licensing patterns which, in practice, might prove to be excessive and hampering.

Furthermore, the Commission has approached this responsibility with full awareness of the important relationship which regulatory controls bear to the vigorous growth and development of a private atomic energy industry. Our policy, put briefly, is one of exerting the minimum of control consistent with the common defense and security, and the health and safety of the public. The Commission believes that its regulations should not impose unnecessary limitations or restrictions upon private participation in the development of the atom's civilian uses, that they should not unnecessarily interfere with management practices, and that such regulations should be enforceable in a practical and uniform manner.

Nine regulations have been published as notices of proposed rulemaking, amended after consideration of comments and issued as effective regulations. These regulations required the Commission to make a number of basic policy decisions. Some of them were by no means easy. In subsequent testimony we would hope to detail some of the more important factors taken into account in formulating these nine regulations.

Both before and after the publication of the proposed regulations, meetings were held with representative groups from the public utilities industry, equipment manufacturers, the chemicals industry, and

research organizations for the purposes of discussing the proposed regulations and obtaining the views and suggestions of these groups. This procedure has enabled the Commission to obtain many views and suggestions from affected groups and the public generally, which were helpful in the future revision of the regulations. During this period the Commission has been issuing licenses and access permits on the basis of the act and the proposed regulations. Our subsequent testimony if you desire it, will give the record of applications received for various types of licenses and the actions taken in respect of them in detail.

As issued, we think the regulations provide appropriate safeguards to protect against hazards to health and safety and to promote the common defense and security. We think also, that they will be practical from the standpoint of the persons who must comply with the requirements. Of course, we expect that experience will suggest the desirability of further revisions and changes. The development of an appropriate regulatory framework, particularly for an industry such as atomic energy, will be a continuing process of revision, adaptation, and, we all hope, of improvement. The rules which have been issued, however, provide the starting point for that process and establish the basic Commission policy and approach for future development.

An important aspect of assistance in the establishment and growth of a private and independent atomic energy industry is the Commission's policy on prices and charges. In last year's testimony we reported to you the steps which had been taken to establish such policy. In later portions of these hearings we will be prepared to discuss our present policies on prices and charges.

There are other aspects of the Commission's comprehensive program to encourage and promote the growth of the atomic energy industry which will be described in the course of the presentation here and which I shall merely mention in this introductory statement such as the vital concern of health and safety of the public, with regard to the processing and use of atomic materials. The Commission will be most meticulous to ascertain, insofar as is possible, that the public health and safety will not be endangered by the operation of any facility. Dr. Libby will later present a statement on that subject. This matter also involves, of course, the factor of insurance protection. There are problems here which are not susceptible of a ready solution. Therefore, the Commission has established a study group of executives of companies representing the four major associations of stock and mutual fire and casualty insurance companies. The Commission is giving continuous attention to this important problem.

The Commission is prepared to report on its policies and actions in such matters as patents, the situation and prospects regarding our supplies of raw materials, and the use of radioisotopes in industry, agriculture, and medicine. We shall also discuss the situation in regard to scientific and engineering manpower as it involves, not only the growth and vitality of the atomic energy industry, but also our national defense and security, and the organizational changes in the Atomic Energy Commission.

We are prepared to report to your committee, Mr. Chairman, on the substantial and gratifying progress which has been made during

the past 12 months in assisting other friendly nations to obtain the many benefits of the peaceful atom. This includes last summer's Geneva Conference on the Peaceful Uses of Atomic Energy which we initiated and which we were happy that so many members of the Joint Committee could attend. We recall with great satisfaction your words to us at the concluding session with your group in Geneva when you said:

> I think I express the sentiment of all the members of the committee when I say, Mr. Chairman, we have been highly pleased with the showing made by the United States at this Conference.

Pursuant to the concept of atoms for peace as stated by President Eisenhower in his address to the United Nations General Assembly on December 8, 1953, and in accordance with the principles enunciated in the Atomic Energy Act of 1954, we now have bilateral agreements for cooperation with 27 countries. Others are in various stages of negotiation, and will be placed before your committee in due course.

The participation of American industry in the domestic atomic energy program is building the foundation for industry's successful, and we hope profitable, entry into the new and rapidly expanding world market for atomic knowledge, services, and equipment. This availability of United States technical and industrial competence to other nations should materially assist the programs of these nations for the development of the peaceful uses of atomic energy.

Thank you, Mr. Chairman, that concludes my prepared statement, and with your permission I would like to outline the topics on which we have prepared additional detailed statements and to seek your pleasure as to the method by which they should be presented.

Chairman ANDERSON. Would you go ahead on that.

Mr. STRAUSS. Our second scheduled item is the present status of reactor development, in which we have divided the matter into the role of the Commission, the experimental reactor program, the growth of nuclear power with subdivisions under that head, the civilian power reactor program, the relation of military power reactors to civilian development, the sale of energy from experimental reactors, and the nonpower use of reactors. For this purpose, members of our staff here from the Reactor Development Division are here, and with your permission I would like to put them on the stand, sir.

Chairman ANDERSON. One of the major questions that concerns me is how much have you boiled down the new things that would be of interest to the American public, and to what degree are these pretty largely the things that have already been printed?

Mr. STRAUSS. I do not believe, Mr. Chairman, that there is anything new or sensational in these presentations, but I believe the fact that they are brought together for the first time and are authoritatively stated has a value from that point of view.

Chairman ANDERSON. Of course, if they are carried in a speech of a member of the Commission, they would be authoritatively stated there, would they not?

Mr. STRAUSS. They would, as a general thing in the speech would probably be more popularly constructed than this statement which is technical.

Chairman ANDERSON. I just look at the volume of this, and it strikes me as rather large.

Mr. STRAUSS. Earlier drafts were larger and longer. It has been cut down.

Chairman ANDERSON. For example, you mentioned yourself a moment ago that you would deal with this question of pricing. Now many people have asked us on that. Are you going to permit industries and other countries to reprocess material which you may furnish them for reactors? Is a question like that answered?

Mr. STRAUSS. Mr. Chairman, that specific question is not answered, since it is a policy question that involves not only the Commission and its determinations, but some defense determinations as well, I do not believe that we could answer that categorically yes or no, without the benefit of further hearings before your committee in executive session.

Chairman ANDERSON. That does not help industry. Industry would like to know something about this, and if this development before our committee is in executive session, industry cannot find out a thing about it.

Mr. STRAUSS. I think this can be said: Reprocessing involves for one type of reactor a fairly simple continuous process. For another type of reactor it involves a very elaborate, expensive, and classified installation. There is no immediate application before the Commission, so far as I know, on the part of any segment of American industry to establish reprocessing facilities in any other country. Is that a fact?

Mr. FIELDS. Not that I know of.

Mr. STRAUSS. We have no such application before us, and I think that it would be premature to expect it.

Chairman ANDERSON. The only reason I raised this now is that as I looked at this volume of material, I only thought that when it was presented and finished we might come back and say, "Now, where in this have you answered these questions that industry and the public generally keep presenting to us?"

I am sure it is your experience that you never go into a press conference without reporters saying, "When are we going to have a policy on this, and when are we going to have a policy on that?" I just wondered to what degree we had been able to cross any of these bridges?

Mr. STRAUSS. We have attempted to foresee as far as possible the questions that might arise, but I am satisfied that as you hear this testimony, and as you put further questions to us, other questions will be suggested which we have not foreseen. We will do our best to respond to them, sir.

Chairman ANDERSON. Are there any other questions or suggestions?

Representative COLE. Mr. Strauss, I have a few questions with regard to your opening statement, and before I start let me say that I feel very much comforted by your statement. The report that was submitted by the McKinney panel created by this committe, the joint committee, to help the joint committee, gave me the impression that the Atomic Energy Commission had not been moving along satisfactorily or sufficiently rapidly in this atomic field, and that greater efforts should be expended. Whether the panel intended the criticism of the Commission or not I do not know. I am sure that all of us are impatient with progress in this field, not only the McKinney Panel Committee but the members of the joint committee and I am

sure the Commission is. But my only feeling is that because of the nature of the activities it is better that we proceed slowly in order that we may be sure of our progress rather than to make haste and create hopes which may eventually be destroyed, not only in this country but throughout the world.

My own information about the Commission's activity has been that it has made great progress in moving along in the peacetime applications of the atom since the law was changed making it possible for the Commission to do it. Now, your statement this morning confirms that impression which I had.

I again reiterate that I am sure that the panel did not intend specific criticism of the Commission, and I intend no criticism of the panel. However, I feel quite sure that the impression which I received in reading the panel report must have been shared by other people in the program and other people in this country—a feeling that things were not going well in the atomic program.

Now, with your statement this morning which I am sure will be supported by the detailed testimony of your staff people, I can at least be reassured that the program is moving along not only soundly but remarkably rapidly, considering the manifold tremendous problems which this great new field presents.

Having expressed myself in that regard, which is by way of an effort to compliment the Commission for the great work it has done, let me inquire more particularly about your statement.

You said that a number of proposals for small-scale reactors were now under consideration. In order to give us some idea of the extent of the interest in this field of reactor development, can you tell us how many proposals for small-scale reactors are now under consideration?

Mr. STRAUSS. There are seven, Mr. Cole. They were received as of February 1. It might be that others may come in, but February 1 was the deadline that we set when this program was announced last September. In all probability an announcement has been made or is being made at the moment, is that right?

Mr. FIELDS. We have a letter that is just about to go out.

Mr. STRAUSS. The 371st letter is probably now on its way with the names in it. Mr. Cole, may I with your permission comment on your first point. I think the Commission is unanimous in not being content with the speed of its work. We would all like to do it more rapidly. There are delays necessary when we are moving into an area as uncharted as this, and where a false step must be avoided. The report of the McKinney panel does contain this paragraph which has been generally overlooked and which I would like to read. It is brief. I think it is a very fine and fair statement.

Representative COLE. Would you identify where that statement is located?

Mr. STRAUSS. This is on page 102 of the first volume of the report. It has to do with the time which the program takes to move. The panel states as follows:

> Commissioners and the Commission organization have reason to be proud of the Commission's accomplishments. There are good reasons why some things may seem to move slowly. No great volume of peaceful uses of atomic energy exists today. There is no table of experience in industrial atomic activities on which to draw in the preparation of rules and regulations. More technological and economic data than are now on hand must be developed before

such experience becomes meaningful. The Commission is more aware of this than are many observers, even than some closely related to it. Drafted under pressure so as to open rapidly the peaceful uses of atomic energy to private enterprise, the language of the 1954 act sometimes seems to confuse hope for eventual development of a flourishing private industry with the misconception that such an industry is already in being. The Commission and its contractors are acutely aware of how much remains to be done and of the time all hands will need to accomplish it.

We were encouraged by that, as indicating that the panel in the months that we worked with it had in connection with the criticism which it found reason to level at us, and we did not think that was excessive, had nevertheless recognized the accomplishments that we have achieved, and the peculiar difficulties that beset the work of this agency.

Representative COLE. It is unfortunate, I think, that that expression to which you have just made reference was not contained in the published résumés or analyses of the reports, and further unfortunate, I think that that expression was not included in one of the conclusions of the panel at the beginning of its report.

Now, to go back to my other question about the small reactors, you say there are seven applications. Is it improper to identify the applicants?

Mr. STRAUSS. I think it is not improper to identify them, and will you do that, Mr. Fields?

Representative COLE. Perhaps it would be unfair to identify them by name. Can you do it in generalities, the type of person or institution or corporation which would be making application for the small reactor program?

Mr. STRAUSS. Will the general manager respond to that?

Mr. FIELDS. I do not believe it would be unfair to identify them by name, sir. I have a letter here which I am about to deliver to Senator Anderson, which is summarizing the proposals. We received these on February 1, and we would have notified the Joint Committee earlier than this but in looking at these proposals they request different forms of assistance, which we have not yet completely priced out, so that although we started to indicate the amounts of assistance that are required, it will take more time to really evaluate this factor and we have eliminated estimates of the amounts requested from the Government in this instance.

However, insofar as the actual proposals themselves, and the sponsors are concerned, I see no reason why we cannot go forward with that. Proposals for small-scale nuclear powerplants have been received in response to the Commission's second invitation under the power demonstration reactor program. They are Chugach Electric Association, Anchorage, Alaska, and Nuclear Development Corporation of America, White Plains, N. Y., proposing a sodium-cooled, heavy water moderated reactor plant with 10,000 electrical kilowatts capacity.

The second is city of Holyoke gas and electrical department, Holyoke, Mass., proposing a gas-cooled reactor with closed-cycle gas turbine with 15,000 electrical kilowatts capacity.

City of Orlando, Fla., proposing a liquid metal fuel reactor plant, with 25,000 to 40,000 kilowatts' capacity.

City of Piqua, Ohio, proposing an organic moderated reactor plant, with 12,500 kilowatts' capacity.

Rural Cooperative Power Association, Elk River, Minn., proposing a boiling water reactor plant with 22,000 kilowatts' capacity.

University of Florida, Gainesville, Fla., proposing a pressurized light water reactor plant with 2,000 kilowatts' capacity.

The last is Wolverine Electric Cooperative, Hersey, Mich., proposing an aqueous homogeneous reactor plant of 10,000 kilowatts' capacity.

Representative COLE. The University of Florida project was 2,000, did I understand?

Mr. FIELDS. That is correct, sir.

Mr. STRAUSS. That is the smallest, Mr. Cole, that we ever have had proposed. It is actually below the limit in the invitation.

Representative COLE. Are any of these seven applications for duplicate ideas, or types of reactors, or are they each different in some major respect?

Mr. FIELDS. I believe they differ one from the other. They differ one from the other as I see it here.

Representative COLE. It would seem if the Commission contemplates financial assistance for these small reactors, and it is understandable, the reason for it, it would be illogical for the Commission to support two parallel projects of identical or similar, if not identical, nature. Is that the policy of the Commission or not?

Mr. STRAUSS. It is a general policy of the Commission, Mr. Cole, but while these proposals have been received so recently they have not been studied and presented to the Commission for acceptance, their bare descriptions indicates that they are different one from another, and of course they are different in size.

Representative COLE. What is the size of the Army so-called package reactor? What is the status of it?

Mr. STRAUSS. I am inquiring to see whether that is classified.

Mr. FIELDS. It is 2,000 electrical kilowatts.

Representative COLE. Can it he told, the status of that project?

Mr. FIELDS. Yes, sir.

Representative COLE. Perhaps we can get it later, but since the question of moving along in the field of small reactors is of current interest, it would seem to me well to indicate the status of that field at present.

Mr. DAVIS. The status of the construction is that ground has recently been broken at Fort Belvoir for the construction of the reactor.

Representative COLE. When you say the ground was broken at Fort Belvoir recently, what do you mean by "recently"?

Mr. DAVIS. About 4 months ago, as I recall.

Representative COLE. When do you expect the construction will have been completed?

Mr. DAVIS. In 1957.

Representative COLE. Will lessons which are learned in that project be helpful in the program for small reactors?

Mr. DAVIS. Yes, sir; the information from that will be very helpful in the development of small reactors. I should point out however, that the objective of this reactor is quite different in some respects from the objectives of small power reactors for civilian use.

Representative COLE. I wish you would point out the differences because I think that is important.

Mr. DAVIS. One of the large differences is that for remote locations we put great emphasis on such things as having a very long fuel-element life, or fuel-charge life which may be beyond the economic life that you would desire in this country. There is the requirement that the plant as designed be transportable by air, which is certainly not a requirement for civilian use in the United States. There also are requirements relating to the type of operators, and the types of controls that we feel are feasible for remote operation by GI's, as compared with operation by experienced powerplant operators in the United States.

Representative COLE. In view of those distinctions, first, the transportability of the reactor, and because of its isolation and the need for long-life fuel, it would seem that the lessons that are learned from that as a project are not going to be very helpful in the program for land-based small type reactors.

Mr. DAVIS. Let me put it this way: The design itself will not be very helpful. The technology that is developed in pursuing the project will be helpful, and will be used where appropriate.

Representative COLE. Thank you.

Now, Admiral Strauss, you indicated in your statement that you had received or the Commission had received 686 applications for access permits. Was that number by individuals or by employer corporations or institutions?

Mr. STRAUSS: It is by individual applications, Mr. Cole. I would assume that in some cases considerably more individuals were involved in an application than one. But there will be specific testimony on that. We can get it now if you wish, except that the chief of that division has not been alerted to atend the sessions except as his subject was to come up.

Mr. PRICE. These are company aplications, Mr. Cole.

Mr. STRAUSS. The number of individuals would be very much larger.

Representative COLE. Can you indicate the number of individuals who might reasonably be covered in 686 applications?

Mr. PRICE. The numbers are in in the prepared testimony, and it is several thousand clearances that have been granted pursuant to these company permits.

Representative COLE. That is enough for the time being. Now, I have one more question, Mr. Strauss. Does the Commission have any recommendations with respect to changes and modifications and amendments in the Atomic Energy Act of 1954?

Mr. STRAUSS. Not in the course of any prepared testimony Mr. Cole. It may develop that during the session we will have some requests to make, or suggestions to make for modifications.

Representative COLE. It would seem that in the course of consideration of the presentation, Mr. Strauss, to the joint committee, in bringing the joint committee and the public up to date in the field of atomic energy, if there had been any roadblocks in the program occasioned by a defect or omission in the act, that would have come to the attention of the Commission and the Commission now would be in a position to make recommendations in that regard.

Mr. STRAUSS. That is right.

Representative COLE. So that the fact that the Commission is not at least for the moment prepared or of a mind that the law should be changed in any particular leads me to the conclusion, which I think is reasonable, that the law is reasonably adequte to carry out the program as it was originally intended.

Mr. STRAUSS. There are minor details on which modification or amendment are apparent to us. The first one that comes to my mind, Mr. Cole, would be an adequate increase in compensation for staff. We labor under continual competition with industry for the retention of our best people, and that is a consideration which, although minor in respect to the principles and policies under which we operate, is vital to the good conduct of the operation. There are other items besides that. We would expect to present them to you well in advance of adjournment in the hope that they might be acted upon.

Representative COLE. The Commission is not unique with respect to the pay of its staff employees, I can assure you, because that is an experience which the joint committee itself is having. Thank you very much.

Chairman ANDERSON. May I go back to what I said a moment ago, about the questions that are being answered? The law says with reference to these hearings, that the Commission shall keep the committee fully and currently informed, and I assume that these 371 documents are in that pattern. But the law also says that these hearings are for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry. Therefore, every word in these volumes is supposed directly to bear on just those three things. It is not past history, but what now constitutes the best judgment of the Commission as to what is needed to be told about the development, growth, and state of the atomic energy industry.

Now, the next paper is on the civilian reactor. A rather quick glance through it sort of suggests that it is modeled a little bit on what is in the semiannual report. It, however, runs some 7,000 words.

The next one is To Encourage Private Enterprise, and it runs some 8,000 words.

The next is on the regulation of industry, and it runs some 9,000 words. It seems to follow the motto of my State, it grows as it goes. There is 25,000 or 30,000 words in this, and I am only asking if it really takes 30,000 words to tell what the Commission believes to be what the committee ought to know about the development, growth, and state of the atomic energy industry.

Mr. STRAUSS. I suppose, Mr. Chairman, it could be done in more or fewer words. Our attempt was not to conduct condensation to the point of making it a capsule report. That might have been done. If you prefer to simply have this introduced for the record, and make this a briefer session, it is all right with us. We would be quite happy to do it.

Chairman ANDERSON. No; I just hope that as they present these papers, they are sure that they have said everything that the Atomic Energy Commission wants to say in this field that bears on the development of growth and state of atomic energy.

Mr. STRAUSS. It has been our endeavor. I would not claim perfection for it.

Chairman ANDERSON. Will you proceed to the next paper?

Mr. DAVIS. I am going to speak on the present status of civilian reactor development.

There is now much greater activity in civilian reactor work and on a much wider front than a year ago. This activity includes research and development effort through laboratory work and the building of power reactor experiments to establish the technological basis for an economically competitive nuclear power industry. There is also growing activity in planning for construction of nuclear powerplants as part of utility systems. These plans are proceeding on stimulus provided by the Atomic Energy Act of 1954 and the Commission's power demonstration reactor program.

The objective of the civilian reactor program is to achieve practical utilization of nuclear reactors for civilian uses. A wide variety of such uses can be visualized. First comes generation of electric power, then commercial ship propulsion, industrial processing, and space heating. Development of reactors for electric power generation comprise the major part of the civilian reactor program. In power and other civilian uses of reactors, economics will be of major importance. The civilian reactor program aims first of all to develop the technology upon which sound engineering and economic evaluations can be made looking toward full-scale applications by industry.

The Commission's civilian reactor program does not have the objective of assuring any fixed amount of nuclear power generating capacity by any given date. Rather, it is recognized that in the final analysis nuclear power will find a role in the differing industrial economies of the world primarily on the basis of its ability to compete with other means of providing power. Therefore, attention is focused on developing technology which will reduce the cost of power production from nuclear powerplants. Experience in the designing, building, and operating of full-scale nuclear powerplants will make important contributions to cost reduction.

Since economics is basic to the program objective, it is essential that the civilian reactor program bring to bear the maximum possible incentives for cost reduction. The normal American business relationships between utility operators and equipment manufacturers, including motives of profit and business survival, provide such incentives. Thus, in the development of nuclear power for civilian use it seems important to foster such relationships at an early stage.

An extensive research and development effort is necessary to provide the technological basis for industrial plants. It is recognized that the principal financial burden in the research and development effort must be carried by the Government. The Commission's role, therefore, should be to develop advanced technology primarily at Government expense and to stimulate developmental or demonstration projects, primarily those with non-Commission financing.

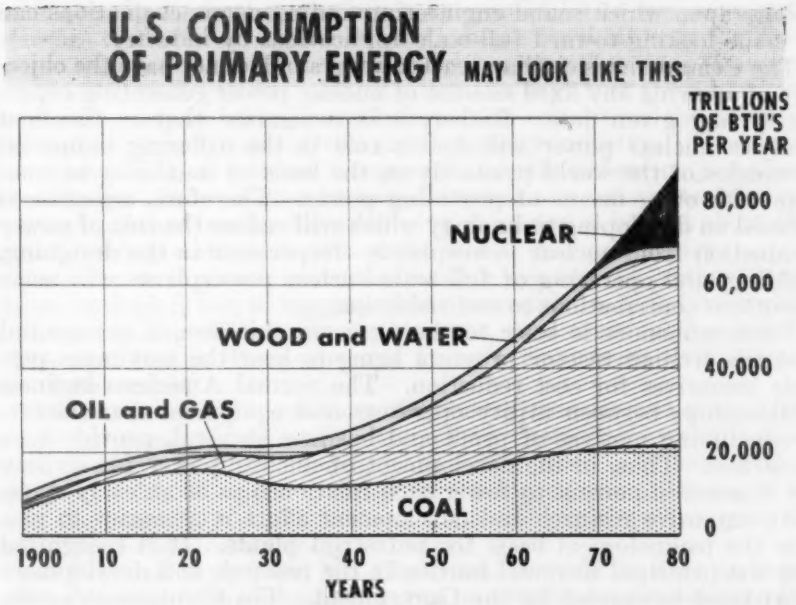
The Commission is supporting research and development to advance the technology on a broad front. The original experimental reactor program formalized about 2 years ago called for construction of 6 experimental reactors to explore 5 different concepts. These included the pressurized water reactor, the boiling water reactor, and sodium-graphite reactor, two aqueous homogeneous reactors, and the fast breeder reactor. These concepts were selected on the basis of promise for ultimately achieving economically competitive nuclear power and on the state of technology. Development of technology essential to

other reactor concepts has continued. As a result five experimental power reactor projects have been added to the civilian power reactor program. These are the organic moderated and cooled reactor, the liquid metal fueled thermal reactor, two modifications of aqueous homogeneous reactors, and a liquid metal fueled fast reactor. These projects broaden the base of our technological advance, and thus improve the probability of achieving economically competitive nuclear power for a wide variety of applications and circumstances.

While the various reactor projects are supported and justified on the basis of specific program objectives—either civilian or military—the technology developed may find use in either field.

Growth of nuclear power. In considering the prospect for nuclear power in the United States, it is useful to compare its projected development with that of other sources of energy. Chart I represents an estimate of future energy demands and what seem now to be likely sources of energy to meet those demands. Estimates are based in part on the report of the President's Materials Policy Commission

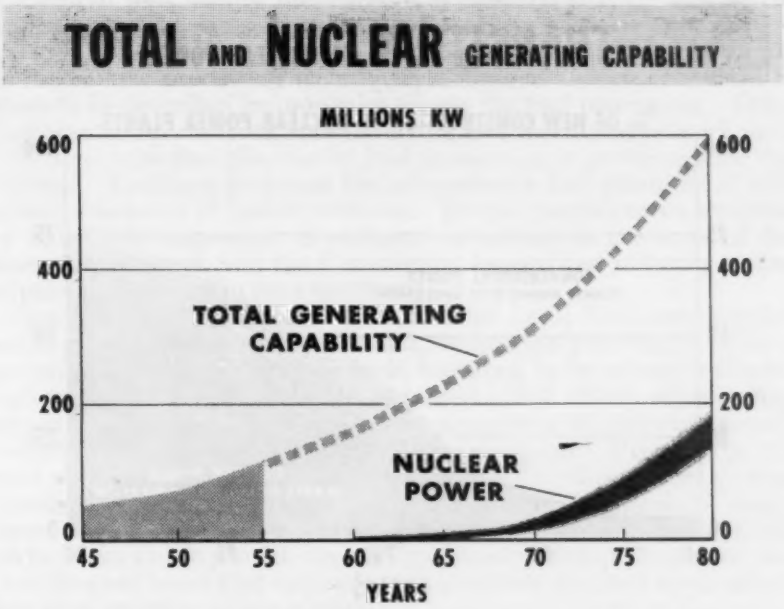
CHART I



and in part on studies made for the AEC. This chart shows total requirements for energy in all forms—not just energy in the form of electric power. Obviously, such a projection is open to challenge on a number of grounds. But we believe it to represent a reasonable estimate of the importance of nuclear energy relative to other energy sources. You will note that fossil fuels are expected to meet a substantial portion of anticipated increased demands for the period shown.

Chart II shows a growth curve for total installed electrical generating capacity in this country through 1980 based on recent estimates published by Electrical World magazine. The projection for

CHART II

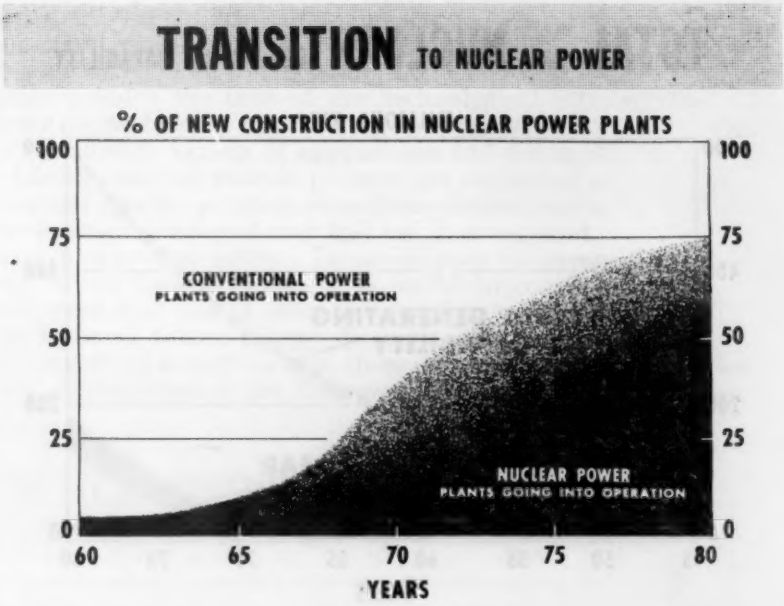


the portion of this total capacity which will be nuclear is based on a number of assumptions. For one thing, nuclear power plants are still very much in the developmental stage. And the margin between present accomplishment and required accomplishment is still so large that accurate predictions of the degree of improvement to be expected cannot be made. Furthermore, the rate of expansion of nuclear power will depend upon the degree of confidence of the producers of power and the manufacturers of equipment in the eventual achievement of economic nuclear power rather than its actual achievement at the time of making their investment. Although nuclear capacity in 1980 may be substantially greater than present total generating capacity of the Nation, capacity from conventional fuels may be about three times our present total generating capacity.

Chart III shows an estimate of the percentage of new capacity to be placed in operation each year which would be nuclear. You will note from the chart that the growth curve can be divided into three phases. The first phase, the one we are in now, is primarily research and development in order to achieve the basis for economic nuclear power. At some point in time the degree of confidence in the eventual economic advantages of nuclear power will become so strong that a relatively large proportion of new powerplants will be nuclear. When this second phase is reached, it is not difficult to foresee the proportion of nuclear powerplants to the total number being built increasing from perhaps 5 percent to perhaps something like 60 percent in 10 years or less. In the third phase when the proportion of new nuclear plants reaches about 60 to 70 percent, the growth may level off. At that point the rest of new capacity will be in hydroplants, very small plants, or in plants located where conventional fuel costs are exceptionally low.

Obviously many factors could change these estimates. The dates

CHART III



shown are for plants going into operation, and design and construction must be started at least 3 years earlier.

Civilian power-reactor program. The civilian power-reactor program consists of three main parts: (1) General research and development financed by the AEC; (2) experimental reactors financed primarily by the AEC; and (3) full-scale reactors financed primarily by industry with limited AEC assistance.

General research and development. The development of power reactor technology requires almost all the branches of science and engineering. The Commission supports a program of research and development from which data and concepts for new reactors or new reactor applications emerge and in which the more fundamental problems applicable to several reactor concepts are investigated. The areas of most critical interest to the development of civilian power reactors are described in the following:

Reactor safety. The Commission is conducting experimental work directed toward a better understanding of the safety characteristics of reactors. Work in this area is detailed in a later section. This work is important not only to discharge our prime responsibility of protecting the health and safety of the public, but also because of the economic effect of safety considerations in the design and operation of reactors.

Fuel processing. The achievement of economically competitive nuclear power depends heavily upon the development of a low-cost fuel

cycle. Since some form of processing of nuclear fuel is likely to be an essential part of any fuel cycle, it is essential that the cost of this processing not be excessive. Development work in this area includes investigations of improvements in processes of existing plants and studies of new processing techniques. Some of the experimental reactors to be described include pilot plants for fuel processing. Other pilot plants also are being considered. Considerably more work needs to be done to reduce the cost of fuel processing in power-reactor fuel systems. Ancillary problems include recovery and commercial utilization or disposal of fission products. Proper participation by industry is believed important to ultimate reductions in the costs of fuel processing services, and the Commission has invited industry to participate as described in later testimony.

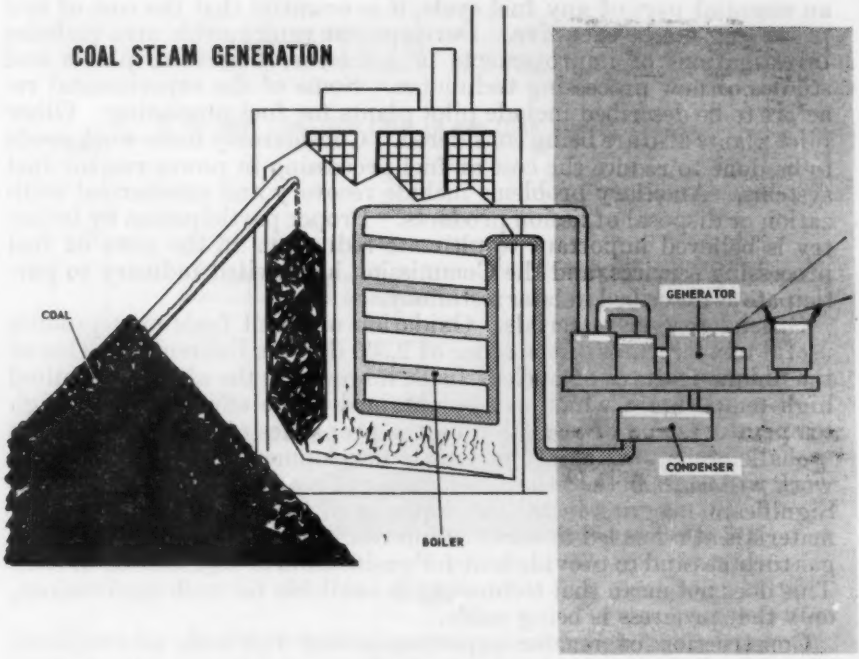
Special reactor materials. Oxidation of fossil fuels may produce useful temperatures of the order of 2,500 degrees Fahrenheit. One of the unique features of nuclear fuels, however, is the almost unlimited high temperature which can be obtained. The effects of very high temperatures and of radiation on the properties of materials present a challenging problem of materials development. Progress in this work will contribute to the development of more efficient fuel systems. Significant progress in the development of high-temperature reactor materials also has led to renewed interest in use of reactors to operate gas turbines and to provide heat for gasification or liquifaction of coal. This does not mean that technology is available for such applications, only that progress is being made.

Construction of reactor experiments and full-scale powerplants. The second step in the development of a reactor from a concept to a commercial plant is a reactor experiment. This pilot-plant stage serves as the mechanism for advancing many aspects of the basic technology program, and provides the means for proving out laboratory findings under operating conditions. The third step in the development of economic nuclear power is the construction of full-scale prototype plants. The first such plant will come into operation during 1957 at Shippingport, Pa. The reactor for this plant is largely Government-financed. The Shippingport plant will provide technical and economic information of value on all types of nuclear powerplants. It is not expected to be an economical plant. However, the related research and development program is expected to make possible the building of a plant of this type that will produce electricity at a much lower cost.

Six other full-scale prototype plants are being planned by 1 public and 5 private groups. Like the Shippingport plant, these are not expected to be economically competitive at the start, but the experience gained in their construction and operation should yield improvements which can reduce costs significantly and help to determine which types of reactors are best adapted to various circumstances.

The eight reactor concepts which we will discuss are all intended as heat sources for electrical generating plants that in all other respects will be conventional. Chart IV shows a conventional plant. This is

CHART IV



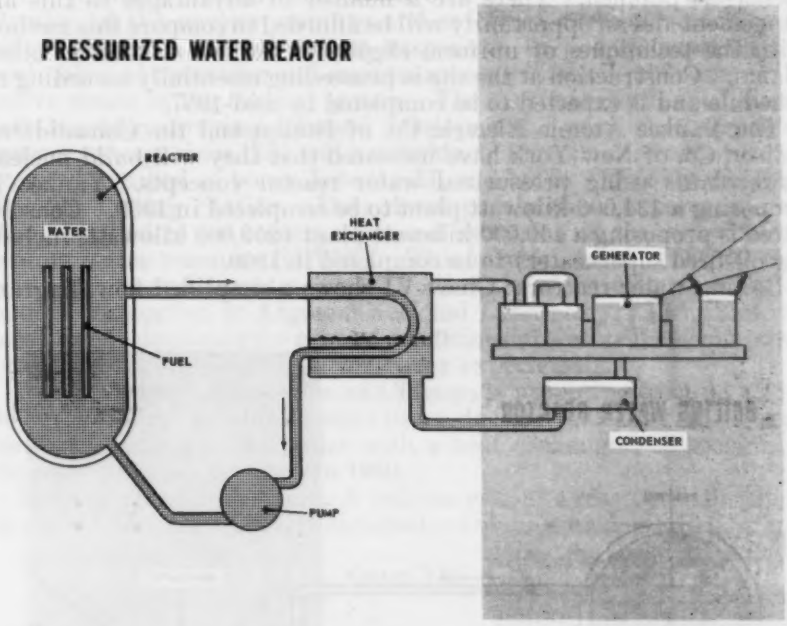
a schematic drawing of a conventional plant. A reactor would take the place of the coal-fired boiler as a heat source to generate steam to drive a turbogenerator which would produce electric power.

The next five charts present the most advanced major reactor concepts.

Pressurized water reactor. A simplified flow diagram of a powerplant using a pressurized water reactor as a heat source is shown in chart V. The fuel rods containing fissionable material are surrounded by water under a pressure of about 2,000 pounds per square inch which serves both as a moderator and coolant. The water is heated by the fuel elements and is pumped through a heat exchanger at about 500 degrees Fahrenheit where it gives up heat to form steam to operate a turbogenerator. The 2,000 pounds pressure prevents boiling at the temperatures reached in the water surrounding the fuel elements at the hottest point.

Because of the relatively advanced state of technology of water-cooled reactors 2½ years ago, the pressurized water concept was selected for the Shippingport reactor, the only experimental reactor now under construction by the AEC as a part of a prototype full-scale powerplant. In particular, experience with the Hanford reactors, the materials testing reactor and the submarine thermal reactor has developed technical knowledge which is being applied in the pressurized water reactor. Water has long been used in industrial and powerplant practice, its properties are relatively well known, and the cooling system is comparatively simple.

CHART V



Although we expect design improvements to bring powerplants using this type of reactor within a competitive range, it seems likely that other reactor concepts being developed will prove more economical in the long run. The cost of reactor pressure vessels—generally in excess of 9 feet in diameter—and piping of the leak-resistant construction necessary with radioactive systems at high pressures is formidable. Since it is an inherent characteristic of water that its vapor pressure increases rapidly with increasing temperature, high pressure systems always will be necessary. It is unlikely that the high pressures required in such systems will ever permit the realization of power conversion efficiencies comparable to modern conventional steam plants. Further the corrosive effect of high temperature water makes necessary the use of materials that are very expensive or have poor neutron characteristics leading to relatively high fuel costs.

Chairman ANDERSON. I hope you will pardon me, Dr. Davis. They are having a rollcall over in the Senate and it will be necessary for me to leave for just a moment. I will return as soon as I can. Congressman Durham will preside while I am away.

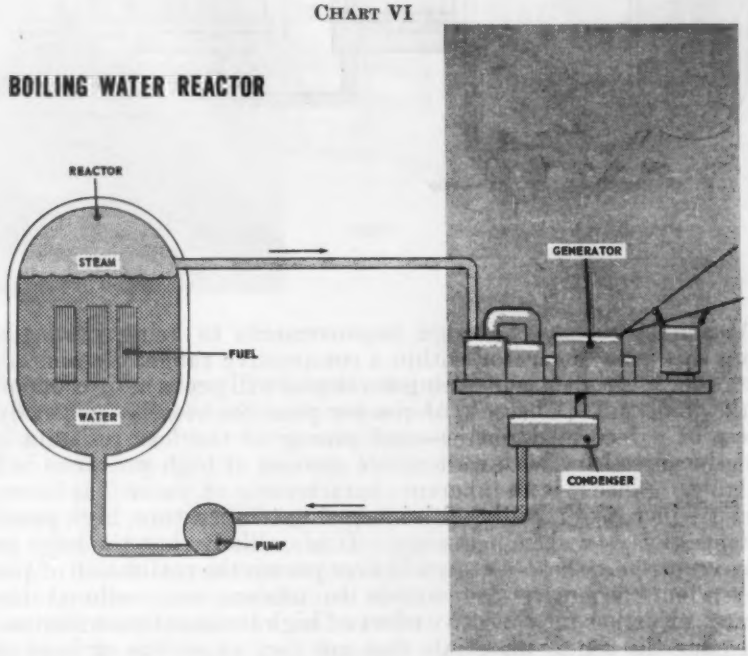
Mr. DAVIS. The plant now under construction at Shippingport, Pa., has a nominal rating of 60,000 kilowatts of electricity but will have a turbogenerator of 100,000 kilowatts capacity. The Duquesne Light Co. is constructing the electrical portion of the plant and, in addition, is contributing $5 million toward the cost of the nuclear portion. The nuclear portion of the plant is being built for AEC by Westinghouse Electric Corp., which also is contributing $500,000 toward the cost of this portion of the plant. A unique aspect of the reactor design is of particular interest. A so-called seeded core—one which utilizes a predominantly normal uranium loading with a few fully enriched ele-

ments—is planned. There are a number of advantages to this arrangement and an opportunity will be afforded to compare this method with the techniques of uniform slight enrichment utilized in other plants. Construction at the site is proceeding essentially according to schedule and is expected to be completed by mid-1957.

The Yankee Atomic Electric Co. of Boston and the Consolidated Edison Co. of New York have indicated that they will build nuclear powerplants using pressurized water reactor concepts. Yankee is proposing a 134,000-kilowatt plant to be completed in 1959. Consolidated is proposing a 140,000-kilowatt plant (250,000 kilowatts including oil-fired superheater) to be completed in 1960.

Boiling water reactors: Chart VI shows a simplified flow diagram

CHART VI



for a plant using a boiling water reactor. Solid fuel elements and water moderation are employed as in the PWR. The basic difference between this plant and the PWR is that the water is permitted to boil, and steam from the reactor passes directly to the turbine. Variations of this type with an intermediate heat exchanger are possible.

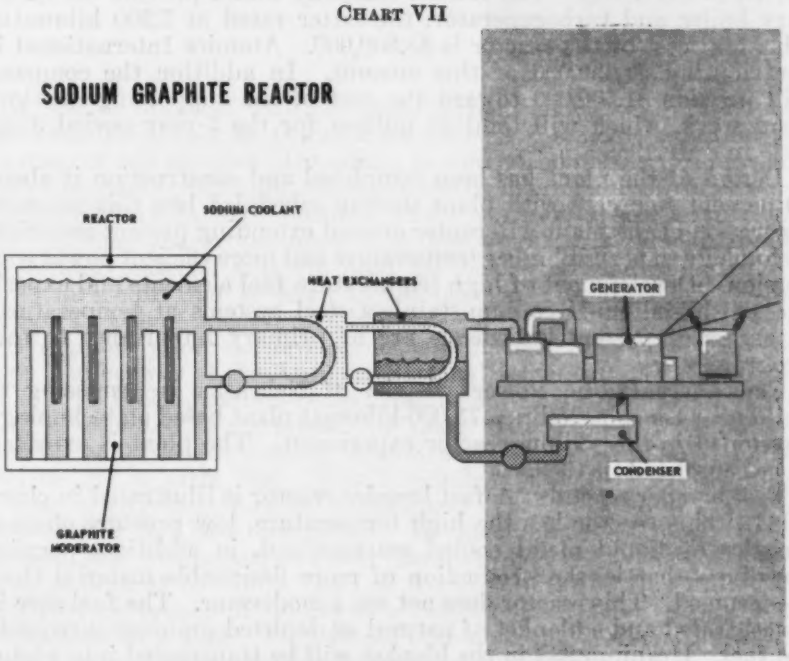
Advantages of this concept are that the entire primary system may operate at a much lower pressure than in the PWR and a major piece of equipment—the intermediate heat exchanger—may be eliminated. With this arrangement, steam pressure and temperature at the turbine may be as high as in the reactor vessel itself. This reactor has an inherent safety characteristic in that any power surge will increase steam formation and reduce the reactor power level. Unfortunately, this response is the opposite of that required in a nuclear powerplant to meet increased load requirements, and control problems are, accordingly, more complex.

The primary problems associated with this concept include demonstration of the nuclear stability and safety of a boiling reactor, development of a control system responsive to power demands and evaluation of operating and maintenance problems in utilizing radioactive steam in the turbine system. The Argonne National Laboratory has been carrying forward developmental work on the boiling-reactor concept since 1953 and has conducted low power reactor experiments identified as borax I, borax II, and borax III at the National Reactor Testing Station. Data developed in these experiments are being applied to the construction and operation of the experimental boiling water reactor (EBWR). This reactor, rated at 20,000 kilowatts of heat and operating at 5,000 kilowatts electrical power, is now under construction at Argonne National Laboratory. The plant will more nearly duplicate the general conditions of a central station power producer than is possible in the borax experiments.

Commonwealth Edison Co. of Chicago is proposing to build a 180,000-kilowatt plant which would use a dual-cycle boiling-water reactor, combining a direct boiler with a heat exchanger. The plant is expected to be in operation in 1960.

Sodium-graphite reactors: A sodium-graphite reactor is illustrated in chart VII. Here slightly enriched uranium is used as a fuel, graphite is used as a moderator and liquid sodium serves as the coolant. Because of relatively high induced radioactivity in the liquid sodium that passes through the reactor, a second sodium loop has been added. Thus, the hazard of generating radioactive fumes from a chemical reaction if the sodium and water accidentally mix is eliminated.

CHART VII



Use of a liquid metal coolant permits the generation of steam in the heat exchanger at temperatures and pressures approaching those of modern conventional powerplants with only moderate pressure in the reactor tank. An additional advantage is the chemical compatibility of the materials used in the reactor.

The problems associated with this concept stem from the radioactivity of the reactor coolant which makes necessary the use of additional shielding and an intermediate heat exchanger. Further, the structure of the core is fairly complex, requiring special attention in design and fabrication. The technology associated with this concept is not as well advanced as that of the water reactors. With the experience that will come from operation of one or more of these plants, it may be possible to eliminate the intermediate heat exchanger, simplify the core design and reduce the tolerances that make the capital cost of this type of plant relatively high.

A sodium-cooled, graphite moderated reactor experiment is being undertaken for the Commission at Santa Susana near Los Angeles, Calif., by Atomics International, a division of North American Aviation, Inc. The reactor is rated at 20,000 kilowatts of heat. A contract is being negotiated under which this heat will be purchased by the Southern California Edison Co. at 45 cents per million B. t. u. and converted to electricity. The Edison company would provide the necessary boiler and turbogenerator, the latter rated at 7,500 kilowatts. The total cost of the reactor is $5,300,000. Atomics International is contributing $1,350,000 of this amount. In addition the company will provide $1,500,000 toward the cost of the supporting development work, which will total $8 million for the 5-year period June 1953 to July 1958.

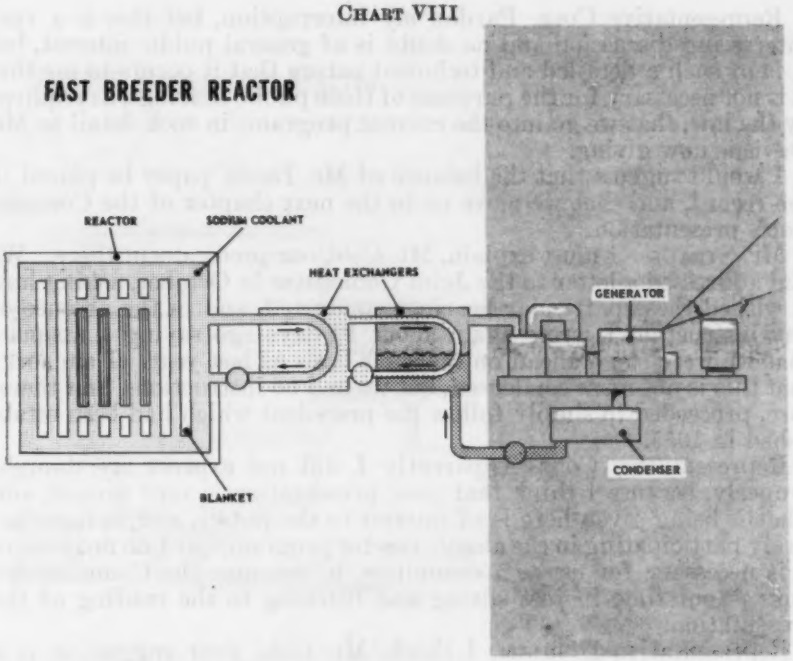
Design of the plant has been completed and construction is about 60 percent complete with plant startup scheduled late this summer. Operation of the plant will center around extending present materials technology to permit higher temperature and more efficient power conversion. Development of high temperature fuel elements and experience with sodium-zirconium-stainless steel systems at temperatures in excess of present knowledge are of primary importance to this program.

Consumers Public Power District of Nebraska is proposing to build near Lincoln, Nebr., a 75,000-kilowatt plant based on technology developed in the sodium-reactor experiment. The plant is expected to be completed in 1959.

Fast breeder reactors: A fast breeder reactor is illustrated in chart VIII. This reactor has the high temperature, low pressure characteristics of liquid metal cooled reactors and, in addition, permits breeding—that is, the production of more fissionable material than is consumed. This reactor does not use a moderator. The fuel core is concentrated and a blanket of natural or depleted uranium surrounds the fuel. Uranium 238 in the blanket will be transmuted into plutonium. Either enriched uranium or plutonium serves as a fuel. Sodium is used as the coolant. Because the sodium coolant becomes radioactive, an intermediate sodium heat exchanger is used which limits spread of this radioactivity in the event of a leak in the boiler.

All the other reactors in this program are thermal, operating with neutrons at energies of less than one electron volt. In contrast, the

CHART VIII



fast reactor operates with neutrons having energies of several hundred thousand electron volts. This leads to the most important advantage of fast reactors—the ability to convert nonfissionable uranium into fissionable plutonium more efficiently than thermal reactors. A program of critical experiments is under way to determine some of the basic nuclear characteristics of this type of reactor. The absence of moderator material and the need for highly concentrated fuel results in a core that is small in comparison with those of thermal reactors. Use of a small core imposes severe heat transfer problems.

The major effort on development of the fast breeder reactor concept is underway at the Argonne National Laboratory. Construction of a solid fueled, sodium-cooled reactor rated at 62,500 kilowatts of heat is expected to start late this year. The plant will be built at the National Reactor Testing Station, and is expected to be completed in late 1958 or early 1959. It will include a pilot plant for fuel processing by pyrometallurgical techniques. The preliminary design of this reactor has been completed. It introduces novel operation of pumps, heat exchanger, and fuel handling mechanisms submerged in a large tank of sodium. The Los Alamos Scientific Laboratory has initiated experimental studies of a fast-breeder reactor using molten plutonium as a fuel. This would eliminate fabrication of fuel elements, permit more complete burn-up of fuel, and minimize chemical reprocessing and heat transfer problems. The major immediate problem is to find a suitable material to contain the molten plutonium alloy at high temperatures in a radioactive environment. The present objective of this project is to get a small-scale reactor experiment in operation about 1959.

Representative COLE. Pardon my interruption, but this is a very interesting discussion and no doubt is of general public interest, but it is of such a detailed and technical nature that it occurs to me that it is not necessary for the purposes of these public hearings, as required by the law, that we go into the current programs in such detail as Mr. Davis is now giving.

I would suggest that the balance of Mr. Davis' paper be placed in the record, and that we move on to the next chapter of the Commission's presentation.

Mr. STRAUSS. I must explain, Mr. Cole, our predicament there. We had addressed a letter to the Joint Committee in October, asking how it wished these particular hearings conducted, and in the absence of any instruction I wrote again about 10 days ago saying I assumed that we were to go ahead on the same basis as last year. I am sorry that this is not more condensed, but we had no instructions, and therefore, proceeded to simply follow the precedent which had been established in 1955.

Representative COLE. Apparently I did not express my thought properly, because I think that your presentation is very proper, and what is being given here is of interest to the public, and to those actively participating in the atomic reactor program, but I do not believe it is necessary for us, as a committee, to consume the Commission's time or our time in just sitting and listening to the reading of the presentation.

Representative DURHAM. I think, Mr. Cole, your suggestion is a good one. I think the procedure is somewhat in detail, as Mr. Cole has outlined. It has been fully covered by the committee heretofore in hearings and other discussions over the past few years.

Now, I think, if there is no objection, we will place the balance of your statement in the record and open this part of the hearing for questions at this point, if that is agreeable with the Commission.

Mr. STRAUSS. Certainly, anything you suggest.

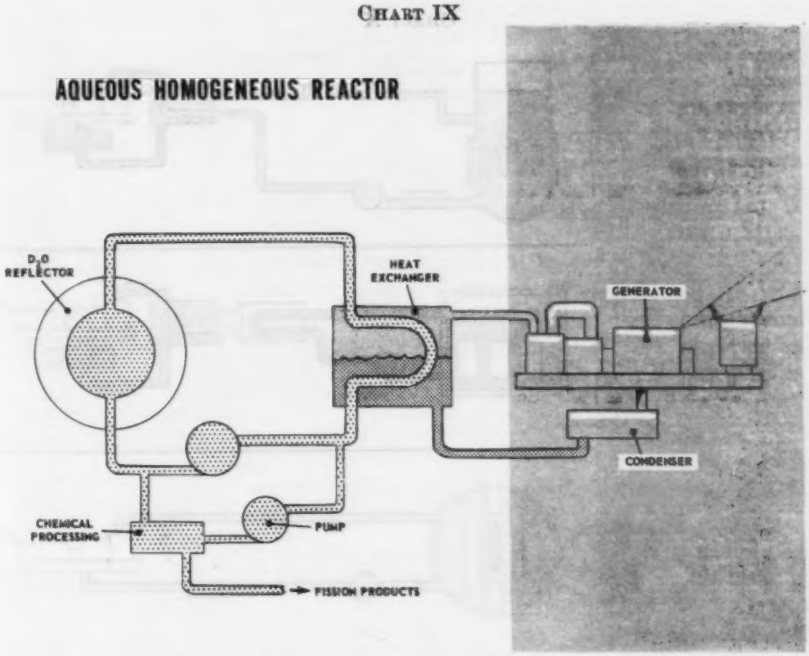
Representative DURHAM. Without objection, we will place it in the hearings, and it is open for questioning.

(The balance of the statement of Mr. Davis follows:)

Power Reactor Development Co., Inc. (Detroit Edison and others) is proposing construction of a 100,000-kilowatt powerplant using a fast breeder reactor. It would be fueled with enriched uranium, use liquid sodium as a coolant, and have a blanket of depleted uranium. A related organization, Atomic Power Development Associates, Inc., and its predecessor organizations, since early 1951 have invested more than $8 million in studies and research and development work on the application of nuclear energy to the generation of electric power. Atomic Power Development Associates, Inc., plans to invest $5 million annually in 1956 and 1957 on further development work.

Aqueous homogeneous reactors.—Aqueous homogeneous reactors utilize either solutions or suspensions of fuel in water. This reactor is illustrated in chart IX. Fuel systems for such reactors in the present program involve uranium in either sulfuric- or phosphoric-acid solutions in either light or heavy water. By combining the fuel, moderator, and coolant in a single solution, the homogeneous reactor bypasses troublesome problems in the fabrication, corrosion, and stability of fuel elements. This reactor offers excellent control characteristics from both safety and power demand standpoints. Continuous chemical processing is a possibility, with new fuel being added and fission products being removed without shutting down the reactor. As in the pressurized water reactor, the solution is kept under sufficient pressure to prevent boiling, and is pumped through heat exchangers where steam is produced. The possibility of continuous removal of fission products, many of which act as neutron absorbers,

CHART IX



makes the reactor attractive as a breeder using U–233 as fuel and thorium as the fertile material. As shown in chart IX, heavy water surrounding the reactor core serves as a reflector. In a breeder reactor this would be replaced by a blanket of fertile material.

The aqueous homogeneous reactor, like a pressurized water reactor, needs high integrity pressure vessels and piping. The chemical solutions used in this reactor are very corrosive to most reactor materials and also exhibit a tendency to break down into undesirable forms under high radiation and temperature conditions.

Oak Ridge National Laboratory is responsible for the major effort on aqueous homogeneous power reactors. Present work is focused on building a second homogeneous reactor experiment. Preoperational testing is expected to begin within a few months.

In addition to the program at Oak Ridge, the Los Alamos Scientific Laboratory is studying homogeneous reactors using uranyl-phosphate solutions. The phosphate solutions should permit higher temperature operation than is possible with the sulfate solutions. However, the higher temperatures may aggravate the corrosion problems. Reactor experiments testing this concept will be conducted this year. Because of its compactness, this type of reactor offers promise as an energy source for small powerplants for remote locations.

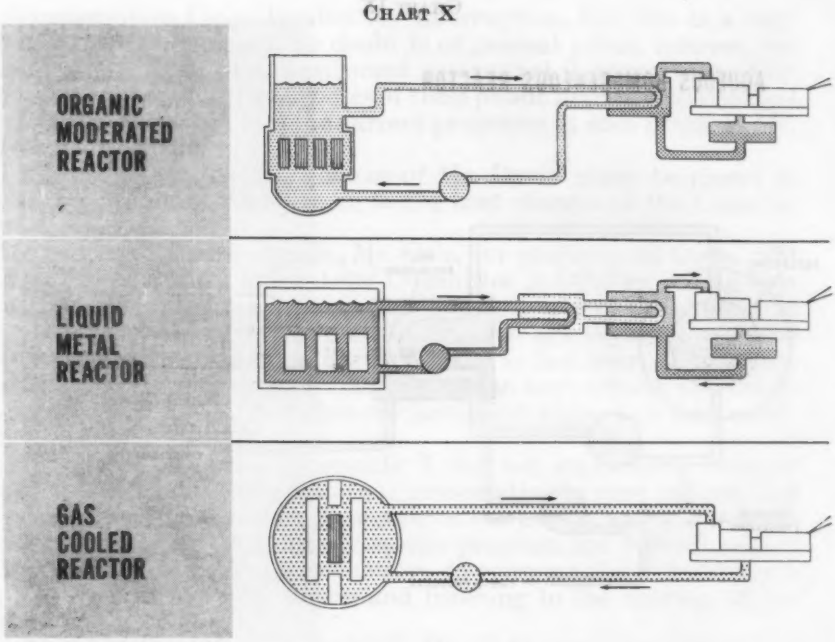
The Pennsylvania Power & Light Co. has announced plans to build a plant of 150,000 kilowatts electrical capacity using a homogeneous reactor. Completion is expected in 1962.

We now turn to three newer concepts that are illustrated on chart X.

Organic moderated reactors.—Organic compounds have several potential advantages as moderator-coolants: low-induced radioactivity, low corrosion of fuel elements, and higher temperature at lower pressures than would be possible with water. As shown in chart X, the organic moderator-coolant absorbs heat as it circulates around the fuel elements and then is pumped through a heat exchanger.

An organic moderated reactor experiment is being designed and its completion is scheduled for late this year at the National Reactor Testing Station in Idaho. Proposals to participate with the AEC in the development of this reactor were invited from industry. Atomics International was selected. The company will contribute $750,000 toward the cost, estimated to total about $2 million.

CHART X



It is planned to operate the reactor for 1 to 2 years to obtain data on the deterioration of the hydrocarbon, fouling, or scale formation on the fuel-element surface, and heat transfer characteristics of the coolant under irradiation conditions. For the first tests, the moderator-coolant will be diphenyl.

Liquid metal fueled reactors.—A liquid metal fueled reactor would combine most of the advantages of the aqueous homogeneous and liquid metal cooled types. Using molten metal as a carrier for uranium, it would operate at high temperatures and relatively low pressures. The temperatures may be high enough to allow steam conditions comparable to those in modern conventional generating plants. The second reactor shown on chart X uses molten uranium-bismuth as a fuel and graphite as a moderator. The molten fuel is pumped through the heat exchanger where heat is removed.

The Brookhaven National Laboratory has been conducting research on the basic technology of this concept. The concept as developed by the Laboratory has been evaluated favorably by an industrial team representing 17 companies and administered by Babcock & Wilcox.

Gas-cooled reactors.—A gas-cooled reactor is attractive if it can be coupled directly to a turbine. With gas temperatures of 1,400° F. or higher, it is possible to attain good efficiency without a heat exchanger or steam boiler. By use of an inert gas, corrosion of fuel elements may be minimized.

Studies of gas-cooled reactor systems have been directed toward determining whether such systems will meet needs for both small central station and mobile nuclear powerplants—the latter especially for military use. The principal problem to be overcome in developing a gas-cooled reactor powerplant which would be economically competitive is the design of fuel elements with a reasonable life expectancy at the high temperatures needed for good thermal efficiency.

The Army reactors program for fiscal year 1957 includes plans for a gas-cooled reactor experiment to supply engineering data for definitive designs of suitable reactor systems. As shown in the illustration of a gas-cooled reactor on chart X, the gas absorbs heat from the fuel elements and gives up energy in passing through a gas turbine.

The cost of the civilian program

Chart XI summarizes developments in the civilian power reactor program. It notes that projects now under way or for which plans have been announced would involve an expenditure of more than half a billion dollars for the development of nuclear powerplants. About half of this total would be expended

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CHART XI

DEVELOPING CIVILIAN ATOMIC POWER

GOVERNMENT'S EXPERIMENTAL PROGRAM	SCHEDULED FOR OPERATION	POWER DEMONSTRATION PROGRAM	SCHEDULED FOR OPERATION	INDEPENDENT INDUSTRIAL PROGRAM	SCHEDULED FOR OPERATION
		FIRST ROUND			
Shippingport, Pa. Pressurized Water Reactor 60,000 KW Westinghouse and Duquesne for AEC	1957	Rowe, Mass. Pressurized Water Reactor 134,000 KW Yankee Atomic Electric Co.	1959	Indian Point, N. Y. Pressurized Water Reactor 150,000 KW Consolidated Edison Co.	1960
Lemont, Ill. Experimental Boiling Water Reactor 5,000 KW Argonne National Laboratory	1956	Monroe, Mich. Fast Breeder Reactor 100,000 KW Power Reactor Development Co., Inc. (Detroit Edison Co. & others)	1960	Dresden, Ill. Boiling Water Reactor 180,000 KW Commonwealth Edison Co.	1960
National Reactor Testing Station Experimental Breeder Reactor 15,000 KW Argonne National Laboratory	1958	Nebraska Sodium Graphite Reactor 75,000 KW Consumers Public Power District	1959	Eastern Pennsylvania Aqueous Homogeneous Reactor 150,000 KW Pennsylvania Power and Light Co.	1962
Santa Susana, Calif. Sodium Reactor Experiment 7,500 KW North American Aviation for AEC	1956	SECOND ROUND			
Oak Ridge, Tenn. Homogeneous Reactor Experiment 2,000 KW (equivalent capacity) Oak Ridge National Laboratory	1956	Elk River, Minn. Boiling Water Reactor 22,000 KW Rural Cooperative Power Association	1960		
National Reactor Testing Station Organic Moderated Reactor Experiment North American Aviation for AEC	1956	Gainesville, Fla. Pressurized Water Reactor 2,000 KW University of Florida	1959		
Los Alamos, N. M. Molten Plutonium Reactor Experiment Los Alamos Scientific Laboratory	1959	Piqua, Ohio Organic Moderated Reactor 12,500 KW City of Piqua	1960		
Los Alamos, N. M. Power Reactor Experiment I & II Los Alamos Scientific Laboratory	1956	Hersey, Mich. Aqueous Homogeneous Reactor 10,000 KW Wolverine Electric Cooperative	Unknown		
Liquid Metal Fueled Reactor (Contractor not selected)	Unknown	Anchorage, Alaska Sodium Cooled-Heavy Wtr. Moderated 10,000 KW Chugach Elect. Assoc., Inc. Nuclear Development Corp. of Am.	1961		
Gas Cooled Reactor (Contractor not selected)	Unknown				
		Orlando, Fla. Liquid Metal Fueled Reactor 25,000/40,000 KW City of Orlando	1960		
		Holyoke, Mass. Gas Cooled Reactor 15,000 KW City of Holyoke	Unknown		
		PROGRAM COSTS (in millions)			
GOVERNMENT	**$ 221.7**		**$ 54.7**		**-0-**
INDUSTRY	**$ 20.2**		**$ 110.1**		**$ 145.0**

The cost of the Government's Experimental Program is the estimated cost of all work from July 1, 1953 through completion of the projects listed. This cost includes the fabrication of cores but excludes the cost of special nuclear materials.

The cost shown for the Power Demonstration Program is based on proposals submitted to the AEC, including modifications through February 2, 1956. This cost excludes the fabrication of cores and the cost of special nuclear materials. Cost included for the Second Round is preliminary and incomplete.

The cost shown for the Independent Industrial Program is based on estimates attributed to the sponsoring utilities.

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by industry and public power agencies, and about half would come from Federal funds.

Relation of military power reactors to civilian development

The Commission's reactor development work for the Army, the Navy, and the Air Force is directed toward meeting specific requirements established by the Department of Defense. At the same time the military programs have made significant contributions to the technology and development of power reactors.

For example, the development of the reactor for the *Nautilus* resulted in such important contributions to nuclear engineering as the metallurgy of zirconium and its alloys; the development of leakproof canned pumps, heat exchangers, valves and reactor mechanisms; and the determination of heat transfer and reactor physics characteristics of pressurized water systems. The development of the reactor for the *Seawolf* made major contributions to the technology of liquid metal cooled reactors, including development of large electromagnetic liquid metal pumps, sodium purification and handling techniques, and liquid metal heat transfer. The operation of both reactors is providing a direct comparison between two competing reactor types for power production.

Operational requirements of reactors for nuclear-powered aircraft call for advancing the technology well beyond that used in other power applications. Shielding with minimum weights, new high-temperature materials, and materials with optimum heat transfer properties must all be combined to produce the high power-to-weight ratios required in an aircraft reactor. Developments in the aircraft reactor program have benefited the other reactor development programs and will continue to do so.

The Army is developing small plants—Army package power reactors—for use at remote locations to provide power and meet space-heating needs. Modifications of these reactors may turn out to be equally well suited to supplying relatively small civilian power needs in high-fuel-cost areas.

Chart XII illustrates the relationship between reactors in the civilian and military programs.

CHART XII

REACTOR FAMILIES - Civilian Power Program with Related Military Reactors

PRESSURIZED WATER REACTORS

CIVILIAN
1- PWR - Westinghouse Electric Co.
Duquesne Power Co.
2- Consolidated Edison Co.
3- Yankee Atomic Electric Co.

MILITARY
4- STR - Westinghouse Electric Co.
5- SAR - General Electric Co.
6- SRS - Combustion Engineering Co.
7- LSR - Westinghouse Electric Co.
8- APPR - ALCO Products, Inc.

SODIUM COOLED REACTORS

THERMAL
CIVILIAN - 1- SRE - North American Aviation Inc.
Southern Calif. Edison Co.
2- Consumers Public Power District

INTERMEDIATE
MILITARY - 3- SIR - General Electric Co.

FAST
CIVILIAN - 4- EBR-1 - Argonne National Lab.
5- EBR-2 - Argonne National Lab.
6- LAMPRE - Los Alamos Scientific Lab.
7- Power Reactor Development Co., Inc.
(Detroit Edison Co. and others)

BOILING WATER REACTORS

CIVILIAN
1- BORAX-3 - Argonne National Lab.
2- EBWR - Argonne National Lab.
3- Commonwealth Edison Co.
4- Rural Cooperative Power Assoc.

MILITARY
5- ALPR - Argonne National Lab.

FLUIDIZED REACTORS

AQUEOUS HOMOGENEOUS
CIVILIAN - 1- HRE-2 - Oak Ridge National Lab.
2- LAPRE-1 - Los Alamos Scientific Lab.
3- LAPRE-2 - Los Alamos Scientific Lab.
4- Pennsylvania Power & Light Co.

LIQUID METAL FUELED
CIVILIAN - 5- Contractor not selected

ORGANIC MODERATED REACTOR

CIVILIAN
1- North American Aviation Inc.

GAS COOLED REACTOR

CIVILIAN
1- Contractor not selected

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Sale of energy from experimental reactors

The installation and operation of facilities for the generation of electric power from energy developed in experimental reactors provides information, technical knowledge and practical experience necessary to the successful startup and operation of full-scale nuclear powerplants. Under the 1954 act the Commission is authorized to sell energy produced incidental to the operation of its experimental and production reactors. However, the sale of energy from experimental reactors has been considered by the Commission to be subordinate to the test operation of such reactors. As has been the case thus far, there appears to be little likelihood that experimental reactors could become the source of firm energy. Prospective customers have been informed that the availability of energy is subject to the demands of the related experimental programs and that no guarantees can be given with respect to quantities or periods of availability.

Despite the unfirm character of the energy, industry has, in the two instances in which energy has been offered for sale, considered the operating experience to be gained to be of sufficient value to justify the installation and operation of generating equipment at no cost to the Government. The Commission has permitted such arrangements in connection with the operation of the submarine intermediate reactor mark A at West Milton, N. Y., and the sodium reactor experiment at Santa Susana, Calif. The first sale of power generated at West Milton was in July 1955. Generation at Santa Susana will commence later this year.

In offering this energy for sale, the Commission has followed the mandate of the act to give preference to public bodies and cooperatives.

In connection with the operation of the SIR mark A, the General Electric Co. constructed a generating station at its own expense. Approximately 12,000 kilowatt-hours were sold on an interim basis to the Niagara Mohawk Power Corp., since none of the interested public or cooperative bodies entitled to preference under section 44 of the act had been able to complete arrangements to receive the power. In order to afford preference bodies further opportunity to purchase the power, the Commission extended until February 1, 1956, the time for submission of firm proposals to purchase, and has indicated its willingness to allow the preference bodies an additional 3 months to conclude transmission arrangements. Two preference organizations—the Ilion, N. Y., Board of Light Commissioners, and the Holyoke, Mass., Gas and Electric Department—have each submitted firm offers in accordance with our invitation. Each organization has offered to buy one-half the power available. Contracts for sale of the power to those organizations are now being prepared.

In connection with the SRE, the Southern California Edison Co. is constructing a generating station rated at 7,500 kilowatts capacity. Prior to entering into negotiations with Southern California Edison, the Commission offered the heat to preference bodies in the area but was informed that they did not wish to submit proposals, since they had received assurances from Southern California Edison that they would have reasonable opportunities to benefit from the engineering, operation, and maintenance experience gained on the project.

NONPOWER USES OF REACTORS

There are many potential uses of reactors other than the generation of power. Many of these other uses are now under investigation or finding increasing application. At present the use of reactors for basic and applied research is the dominant application, although use for food preservation and space and process heating may develop more emphasis.

Research reactors

Nuclear reactors have proved to be important tools for research in a variety of fields. They have been utilized extensively in research programs at the Commission's national laboratories, and private institutions also have recognized their advantages. As a result of this extensive experience, several standard designs have been developed and research reactors of several types and sizes are being offered at fixed prices by private industry. Two research reactors now are in operation on university campuses, a third is under construction, and several other universities have indicated interest in building reactors. Interest is not confined to universities; three other private research institutions also have applied for licenses to construct research reactors. To encourage the construction of research reactors by nonprofit educational and medical institutions, the

Commission has established a policy of providing assistance to such research reactor projects.

Research reactor uses.—Research reactors are useful primarily as sources of nuclear radiations, such as neutrons and gamma rays. They can be used in many types of research, ranging from basic studies in nuclear physics to a variety of applied research projects, such as the activation of chemical reactions by radiation, the experimental preservation of foods, and studies of the effects of radiation on various materials. They are valuable tools in reactor development, since they can be utilized to study the effects of radiation on components and materials proposed for use in production and power reactors. Their research applications are not confined to the physical sciences; they may be used in medical therapy and in various biological studies, such as research into the effects of radiation on living organisms and the production of new strains of plants through irradiation of seeds. They are valuable training devices, both because they allow actual experience with reactor operations and because they stimulate various kinds of research.

At present, particle accelerators are much more widely utilized than reactors in university research programs. There are several reasons for this. First, reactors were developed more recently, and there has been less time for their incoporation into university research programs. Second, until the passage of the Atomic Energy Act of 1954, restrictions on the allocation of reactor fuels prevented private construction and operation of some types of research reactors.

The act of 1954 eased the restrictions on providing fuel for private reactors. At present, the principal problems involved in wider utilization of research reactors by universities appear to be those of finding the necessary funds and competent personnel, in competition with other demands upon universities for money and trained manpower. Universities may be expected to overcome these obstacles because of the many advantages of research reactors. They are extremely versatile tools. They can be used not only for many different kinds of research, but often for several simultaneous investigations in different fields. They have reliable operating characteristics, and they produce useful byproducts in the form of radioisotopes. They also may be utilized in the training of nuclear engineers.

Research reactors in operation or planned.—The first university research reactor has been in operation since September 1953, at North Carolina State College of the Consolidated University of North Carolina. Another research reactor began operation in 1955 at Pennsylvania State University, and a third is under construction at the University of Michigan. A medical reactor, discussed in another section of this presentation, has been authorized for the University of California at Los Angeles. Several other universities have indicated interest in building research reactors.

Not only universities, but also research institutions have plans underway to build research reactors. The Commission has granted construction permits for research reactors to the Armour Research Foundation, and Battelle Memorial Institute, and the Applied Nucleonics Corp. has applied for a construction permit. A construction permit for a research reactor also has been granted to the Naval Research Laboratory.

REACTORS FOR MEDICAL RESEARCH AND THERAPY

The first two reactors designed specifically for medical applications were authorized in 1955. One will be located at Brookhaven National Laboratory and the other is planned for location at the University of California at Los Angeles. These reactors will offer special advantages over other forms of radiation therapy, and will have important applications in medical research. Their construction will be a significant step forward in the application of atomic energy to medicine.

Brookhaven reactor.—The existing reactor at Brookhaven has been utilized for medical studies, but it has been obvious for some time that a reactor designed and used specifically for medical purposes would have a number of advantages. Medical studies utilizing the present reactor have had to compete with many other demands for use of the instrument. Only two ports in the reactor have been available for medical use: (1) a small facility on the west face for instrument studies and radiation of small animals, and (2) a port on the top of the reactor which has been used for experimental treatment of two series of brain tumor cases with neutron-capture therapy. Separation of the reactor from hospital facilities by a distance of about 1 mile has resulted in difficulties in the use of the reactor for treatment of patients.

The increasing demands at the laboratory's medical department for sources of neutrons and for other types of radiation suitable for studying the biological effects of radiation and for investigating clinical uses led to the authorization of the medical reactor. The reactor will be an integrated unit of Brookhaven's new hospital and medical research complex.

The reactor design is based on reports by Nuclear Development Associates as well as features developed by Brookhaven's reactor operators and nuclear engineering and architectural planning groups. Many design details remain to be decided. The reactor will operate at power levels up to 1,000 kilowatts and will use fuel plates similar to those of "swimming pool" reactors. Air-cooled graphite will be the moderator-reflector, and the core will be cooled by light water. The graphite reflector will surround the core on all sides, except at the top. An exhaust stack will be used for safe disposal of the cooling air.

One face of the reactor will be entirely devoted to facilties for treatment of human patients, and similar facilities on the opposite face will be used for irradiation of animals. One of the remaining faces will have a port suitable for exposure of animals.

The thermal neutron flux available from the reactor will be between 10^{10} and 10^{11} (10 billion to 100 billion) neutrons per square centimeter per second. This will be about 10 times higher than the neutron flux available from the present research reactor. The higher flux is expected to produce a considerable improvement in the results of brain tumor therapy.

It is expected that the reactor will be completed during the first half of 1957.

UCLA reactor.—The medical reactor at the UCLA Medical Center will be constructed by North American Aviation, Inc., at an estimated cost of approximately $185,000. It is expected that the reactor building will be provided by the university. This reactor will differ somewhat from the one planned for Brookhaven. It will be of the homogeneous type, using a solution of uranium sulfate as fuel, and will operate at 50 kilowatts. Its uses will be identical with those of the Brookhaven reactor, except that some limitations will be imposed by its lower power level.

It is anticipated that the reactor will be completed in 2 years. It will be available in part to the atomic energy project at UCLA, where programatic research is supported by the AEC.

Commission research reactor policy.—The Commission has adopted a policy of providing certain assistance for research reactor projects to nonprofit educational and medical institutions. For such projects, the Commission will waive charges for the use of special nuclear materials and heavy water and for consumption of special materials used in operation of the reactors. In addition, the Commission will provide funds or services without charge, for the fabrication of fuel elements, preparation of fuel solutions, reprocessing of fuel used, and preparation of neutron sources. The assistance granted under this policy will continue until July 1, 1960, at which time the Commission will reassess it.

To qualify for assistance the applicant must establish that the facility will be used in a program which may be expected to contribute significantly to the application of reactor technology, biology, and medicine, engineering or other fields of sciences. The policy applies to research reactors in operation or under construction as well as to new projects.

In return for the assistance, the institution will enter into an agreement which will include patent and reporting provisions. The Government will determine patent rights on patentable modifications of the facility itself and on processes useful in the production of special nuclear material. These rights will allow the Commission to make available to others any improvements in research reactors resulting from work carried out by institutions receiving assistance. The institution would also make any information, developed through the use of the facility available to the Commission for further distribution.

The Commission believes that this policy will provide stimulus to universities and hospitals to undertake additional research reactor projects.

Food preservation

Another area in which reactors may increase in importance is the preservation of food by irradiation. The Army Quartermaster Corps, after 3 years' study in food preservation by irradiation from prepared sources and spent fuel elements has now requested the AEC to develop and construct a reactor or other facility for processing 1,000 tons of food products monthly. Such a facility will permit the Quartermaster Corps to enlarge substantially its investigations in food preservation.

Space and process heat

Nuclear energy may become an increasingly desirable source for space and process heat to supplement demands on more conventional sources as national requirements increase. By far the larger part of energy comes from sources whose form is not critical. Economic criteria alone govern the choice of fuels for space and process heat. The cost of heat from fissionable fuels is expected to decline substantially. The increasing value of the hydrocarbon content of fossil fuels as an industrial raw material, coupled with expanding demands for energy for all purposes of the order indicated in chart I, suggest that the use of atomic energy for space and process heat may become economically attractive.

Space heating applications have been included in developmental work for the Army. The Army Package Power Reactor (APPR) now under construction at Fort Belvoir by Alco Products, Inc., is a prototype for military plants designed to supply from 3,000 to 6,000 kilowatts of steam heat as well as from 1,000 to 2,000 kilowatts of electric power at remote installations in the Arctic. The Argonne Low Power Reactor being developed at Argonne National Laboratory for the Army, will also be a prototype for plants to provide both heat and electric power, but will have only about one-tenth the capacity of the package power reactor.

Representative DURHAM. Mr. Cole, do you have any questions?

I might ask 1 or 2 questions myself before we proceed.

Can you give us at this point what this overall reactor program will cost the Commission this year? That is, our participation to the extent of aiding civilian purposes.

Mr. DAVIS. You mean the total of the Commission's research and development program?

Representative DURHAM. The total amount of money that you plan to spend this year. That can be given in a public record.

Mr. DAVIS. Sir, I do not have the figures with me, but I would be glad to supply them for your committee.

(The information referred to follows:)

Civilian power reactor projects and advanced engineering related to civilian power—estimated costs, fiscal year 1956

[Thousands of dollars]

	Operating budget	Plant and equipment budget	Total
Pressurized water reactor	$12,600	$12,000	$24,600
Boiling-water reactor	5,114	808	5,922
Homogeneous reactor	8,200	678	8,878
Fast breeder reactor	4,905	3,423	8,328
Sodium graphite reactor	3,375	0	3,375
Liquid metal fuel reactor	2,000	0	2,000
Organic moderated reactor	600	0	600
Gas-cooled reactor [1]	300	0	300
Advanced engineering and separations systems [2]	11,570	0	11,570
Total estimated costs	48,664	16,909	65,573

[1] A single developmental effort is underway which is applicable to both civilian power and military programs.

[2] Reactor safety, $2,770; other advanced engineering and separations, $8,800.

Representative DURHAM. I think it is important for us to know somewhere around what it is going to cost us at this point.

Mr. DAVIS. It is roughly—excluding one program—it is of the order of $40 million, but I do not have the exact figures.

Representative DURHAM. Does that include the military, as well as the civilian?

Mr. DAVIS. That is only the civilian part of the program.

Representative DURHAM. Are we participating to any extent with the expenditure of funds in the Army program and the Navy program, or are they paying entirely for that?

Mr. DAVIS. No, sir; the Commission pays for the reactor-development work which is done to meet the stated requirements of the Army and the Navy and the Air Force.

Representative DURHAM. In other words, we are paying for the experimental work——

Mr. DAVIS. That is correct.

Representative DURHAM. That is being carried out.

Mr. DAVIS. Yes, sir.

Representative DURHAM. What does that include? Does that include paying Army personnel and Navy personnel?

Mr. DAVIS. No, sir.

Representative DURHAM. We only pay our own personnel?

Mr. DAVIS. We only pay our own personnel.

Representative DURHAM. Doing the research work.

Mr. DAVIS. That is correct.

Representative DURHAM. Are there any questions?

Representative PRICE. Practically every reactor program that you have enumerated so far is an old concept, 3 or 4 or 5 or 6 or 7 years old. Is there any new concept in the field of reactors that you have been working on, or experimenting on?

Mr. DAVIS. Well, I would say that some of the variations of some of the existing ones are new. The liquid metal fuel fast reactor that I mentioned Los Alamos is working on—that is a relatively new concept. The liquid metal fueled reactor that Brookhaven has been working on for several years is still relatively new. We have also these aqueous homogeneous reactors Los Alamos is working on, that represents a new type of aqueous homogeneous reactor. Some of the new boiling-water concepts that we have mentioned are new. There is the dual cycle one, that is an adaptation of the one that Argonne has been working on, which contans a novel feature. One of the boiling reactors proposed under the second round is essentially a novel feature, in the heat exchanger. Another type of reactor which has been proposed under the second round, the heavy water moderated liquid sodium-cooled reactor is quite a novel concept. We are getting some novel concepts as a result of our work.

Representative PRICE. For instance, the experimental liquid metal reactor is not new. That is 6 or 7 years old.

Mr. DAVIS. The experimental liquid metal fuel reactor, and, I think, the bismuth-cooled reactor that Brookhaven is working on are about 5 years old or thereabouts.

Representative PRICE. What is the status of the homogeneous reactor?

Mr. DAVIS. We hope the reactor experiment there will go into operation some time this spring. That, as you know, represents really a pretty broad class of reactors, and it cannot really be called a single specific reactor. There are many different combinations, blankets and cores, that are used, and there are really a number of possible ones there.

Representative PRICE. What would be new or advantageous in some of these other new concepts that you have sketched over here just a moment ago?

Mr. DAVIS. Some of them would appear to give promise of being useful for particularly small nuclear powerplants, for example. The idea of the homogeneous reactor that Los Alamos is working on would seem to be particularly applicable to small-scale plants. It has one unique feature that I did not mention, which is the incorporation of the heat exchanger inside of the reactor vessel itself, which gives you a very compact and very small system. The liquid metal fueled fast breeder which would use an alloy of plutonium and some material as a fuel, and in turn would be cooled with liquid metal, offers some promise, although we are just beginning its development. It would appear to solve some of our problems of heat transfer and fuel elements in this type of a system.

Representative PRICE. If one of the family of homogeneous reactors proves successful, what effect would it have on the other reactors, the reactor concepts, and the reactor families?

Mr. DAVIS. You mean the other homogeneous ones?

Representative PRICE. If the homogeneous reactor proved very successful, would it have any effect at all on the other family of reactors?

Mr. DAVIS. I expect it would have some effect, but I believe that we are going to need more than one type of reactor to take care of the various requirements, so that if it were successful I am sure it would be widely used, but it would not result in the abandonment of the other types of developments.

Representative PRICE. What I am trying to get at in my thinking, and I am just thinking through this, is this: Would it be conceivable that a homogeneous reactor would out-date any other type of reactor which you had?

Mr. DAVIS. It is very difficult to say now what such a development might actually do. You would have to postulate what is happening in the development of the other competing types of reactors at the same time. It is quite possible as time goes on, some of our reactor concepts are going to prove not to be too good, and will be dropped, but it is much too early at the present time to say which ones we might have.

Representative PRICE. You have not reached a point where you can quit experimenting or development of any one type of reactor?

Mr. DAVIS. We have not dropped any of them in the last year, certainly.

Representative PRICE. I notice, Mr. Davis, you mentioned the safety factor in the reactor program. What has been your experience so far in the safety factors, in all of your reactor programs since the beginning of the atomic energy program?

Mr. DAVIS. It has been extraordinarily good.

Representative PRICE. You never have had any major or serious accidents resulting from the reactor itself?

Mr. DAVIS. We have never had any accidents where people have been seriously injured or killed.

Representative PRICE. The reason I bring that point out is that I imagine that the private industry going into the reactor business and power business, people in a different area may have some degree of fear of these reactors. The experience and my observation has been such that there will be little cause for fear on anybody's part because of the location of these reactors.

Mr. DAVIS. This is one of the things we are interested in in the development of different kinds of reactors, because there probably will be some kinds that will turn out to be safer than others, in the long run. I believe that this will be so. They may not turn out to be the most advantageous economically, so you may have on the one hand people building safe reactors in more heavily populated areas, and people perhaps building less safe reactors in remoter spots, in order to get some economic advantages.

Representative PRICE. While you have always given very close and serious attention to safety factors—you have gone almost overboard in the matter of safety, and rightfully so—this is not a criticism because this is new and everybody has to prepare for any hazard—there has been nothing so far that should leave the public with any fear because a reactor happened to be built in the vicinity of the various residential areas of the country.

Mr. DAVIS. There certainly are kinds of reactors that can be built if proper precautions are taken. There is no concern that should be felt.

Representative COLE. Along the line of questions raised by Mr. Price, which to me are very interesting, Dr. Davis, apropos of the various possible types of reactors I recall that Dr. Zinn once said that it is conceivable there would be as many as a wagonload of various types of reactors. Excluding yourself and present company, I dare say you would agree with me that Dr. Zinn is probably the outstanding scientist and expert in the field of reactors.

Mr. DAVIS. I quite agree.

Representative COLE. I am curious to know if that thought which Dr. Zinn expressed 6 or 8 years ago still prevails in the fraternity of reactor scientists.

Mr. DAVIS. To the best of my knowledge, it does.

Representative COLE. So that when we say we have started on a program of 6 or 8 or 10 or 12 dozen types of reactors, we must bear in mind that we are just starting and making even at that a tiny start, and that tiny start is going to cost millions and millions of dollars, and it will be many, many, many years before the whole wagonload of possible reactors is fully tested and explored; is that not correct?

Mr. DAVIS. I agree with you.

Representative DURHAM. Commenting on that point, Dr. Davis, I am thinking of your family at the present time, of 6. Those are the pressurized water reactors, and the boiling water reactors, and the organic moderated reactor, and your sodium-cooled reactor and the gas-cooled reactor. That covers your entire family at the present time that you have actually in existence and also are building; is that correct?

Mr. DAVIS. Well, it covers more than we have actually built.

Representative DURHAM. It covers more than you actually have built, but you are either in the experimental stage or building or you are attempting to see whether or not there is a proper field there.

Mr. DAVIS. Yes, sir.

Representative DURHAM. In arriving at that conclusion, and I am thinking about the wagonload idea, and of course I think Mr. Cole and Dr. Zinn were right and I remember that remark, but also we have to bear in mind that it requires a tremendous amount of personnel of specially trained types to carry out such a program.

In arriving at this decision, of your reactor family at the present time, does the Advisory Committee in any way advise you as to going into a new type of reactor, or do you just make that decision in the Commission, or who makes it?

Mr. DAVIS. I would say that the decision is made in the Commission, but that the General Advisory Committee has a Reactor Subcommittee which conducts reviews and discusses our program with us, and I believe if they did not agree with us they would tell us so.

Representative DURHAM. You do, in other words, use their advice in arriving at your decisions to take on another different type program, is that correct?

Mr. DAVIS. We certainly discuss the program quite frequently.

Representative DURHAM. As far as the details involved, as to personnel or anything else, as to whether you can carry out such a program?

Representative COLE. Has the General Advisory Committee ever expressed disagreement with the Commission's decisions with regard to the reactor development program?

Mr. DAVIS. Not that I can recall, sir.

Mr. STRAUSS. I might say, Mr. Chairman, we keep the General Advisory Committee almost as fully and currently informed as we do your committee. Obviously, they are not concerned with a number of details of nonscientific nature, but everything else, all of the technical matters are communicated to them promptly, and usually at the same time as the letter is written to your committee.

Representative COLE. Has the Advisory Committee made recommendations to the Commission in the reactor field which the Commission has not approved or endorsed?

Mr. STRAUSS. I do not recollect any such recommendations, Mr. Cole, in recent years. There was one a number of years ago with respect to the location of reactor research, but it had nothing to do with types of reactors.

Representative COLE. It was geography?

Mr. STRAUSS. Location of a laboratory, and the question of whether research should be centralized in one place.

Representative COLE. Has the Advisory Committee ever expressed dissatisfaction with the progress of the Commission's reactor program?

Mr. STRAUSS. Not to the Commission, and I do not think they have otherwise.

Representative COLE. That is all.

Representative DURHAM. Would they take any part in the advice as to a civilian coming in and making application to build a certain type reactor?

Mr. STRAUSS. No, Mr. Chairman, they are not involved in any such consultation.

Representative DURHAM. That would be entirely between the Commission and a civilian?

Mr. STRAUSS. That is right.

Representative DURHAM. In arriving at a conclusion, if some individual comes in with an entirely different idea, or should come in with an entirely different idea from what you have in the present family here, he would get just as much consideration for his idea and

the right to prove whether it was sound or unsound as far as the Commission is concerned, is that correct?

Mr. DAVIS. Yes, sir; we are encouraging people to come to us with ideas, and if they look interesting, why, we certainly try to follow them up.

Representative DURHAM. I am thinking of a civilian making application for reactors; he might have the fear that, "I am not going to get much consideration when I go down there at the Commission, so what is the use of my spending my time endeavoring to build something new and something that they have not thought of?" Now, of course, you would explore the idea as fully as you could as to whether it was feasible.

Mr. DAVIS. We would encourage people to do that, sir.

Representative DURHAM. I think our whole program lies in the reactor program, and I have always felt like it was something that should be fully pushed at all times and as fast as it can be. Personally, I have always been very well pleased with the program that the Commission has tried to develop, and I think that we have made very, very excellent advances on it, and I think that has been proven; it was proven in Geneva, certainly, and I think we are still, I feel—and I do not know whether the Commission feels we are—but I think we are still far in the lead in the world in the building of reactors. Does the Commission have the same opinion at the present time?

Mr. STRAUSS. I do not know that there is a Commission opinion on it, sir. I believe it is certainly the opinion of individual members, or some of the individual members of the Commission. It is somewhat difficult to evaluate the relative status of, let us say, our reactor program and that of our British friends. Their reactor program is devoted not only to the production of power but to the production of plutonium. Therefore, the economy, or the question of the competitive place in the economy, of England is hard to discover. One does not know what value they will place on the plutonium.

Representative DURHAM. I am speaking primarily, Mr. Chairman, of across the board.

Mr. STRAUSS. I think, across the board, we are at the present time well ahead. But as I say, that is not a Commission position as such.

Representative DURHAM. I should not have asked it as a Commission viewpoint. Are there any further questions?

Representative PRICE. I would like to ask a question.

Mr. Davis, in the commercial program, the participation of private industry, when they come into the program do they make their own selection of the type of reactor with which they want to experiment?

Mr. DAVIS. Yes, sir; they do.

Representative PRICE. What has been your experience in the selection? Have they gone pretty much to the same type, or have they been diversified in their selection?

Mr. DAVIS. We have been rather interested by the fact that almost each company which has become interested in a reactor project has chosen a different type.

Representative PRICE. Has there been any type in your program that the Commission is hot on but which has not been selected by private industry?

Mr. DAVIS. At the present time, and at the present stage of development, I do not believe so.

Representative PRICE. You do not think so?

Mr. DAVIS. No; we have a good representation.

Representative PRICE. Now, is there any work being done on either the transformation of material under radiation or the use of radiation as a catalytic agent to cause any processes to take place?

Mr. DAVIS. It is my understanding there is a great deal of interest in both of these subjects industrially. There are a few companies in these fields.

Representative PRICE. What is the advantage of such an action, or reaction?

Mr. DAVIS. What are the advantages of carrying out chemical reactions by radiation? I believe they would rest largely in being able to create newer and different products. There might be the advantage of being able to do this with less expenditure of energy.

Representative COLE. Would you mind explaining to me what you and Mr. Price are talking about?

Representative PRICE. We are discussing the use of radiation to carry out physical changes in materials which would improve their properties, or to carry out chemical reactions by passing some materials through a reactor and producing some chemical product from it, if I understand Mr. Davis correctly.

Mr. STRAUSS. In the statement which Dr. Libby will present, this matter is treated with in more detail.

Representative PRICE. I think earlier in the hearings Chairman Strauss mentioned the fact that the University of Florida application was below the limit in kilowatts and capacity. What is the limit in that program?

Mr. STRAUSS. When I said "below the limit," if I used the word "limit," Mr. Price, it was unfortunate. We set certain bounds in calling for the power demonstration reactor program, the small proposals, but it was not with the desire of actually limiting the proposer, and a proposal for a 2,000-kilowatt reactor is not necessarily disqualified because it is below the 5,000 figure. I think 5,000 was the figure we mentioned.

Representative PRICE. Now, also, I heard a while ago, you mentioned the fact when we were discusisng with Mr. Cole what could be some possible recommendations on changes in the law, about the remuneration of the people within the program, and I am sure that you know that almost our entire committee agrees with you on that subject.

But do you have any difficulty, aside from the remuneration angle, in finding qualified scientists and technical people in the program?

Mr. STRAUSS. I would not say that the Commission is in any different position than American industry there. There is a shortage of qualified personnel overall and the Commission's difficulty in finding people is paralleled by that of the great companies of the country. As a matter of fact, if you look into the New York Times or any of the great metropolitan dailies in their Sunday issues, you will ordinarily see a section of a number of pages of display advertising offering opportunities to scientists and technicians in the employ of other companies, presumably.

The Atomic Energy Commission does suffer from the disadvantage that we have a ceiling placed on what we can offer, and in many cases there are members of our staff who are serving the Commission at a very much lower salary than have offered to them by companies,

from a sense of duty and an interest in the work. That is a rather tenuous hold to have on people. It is to some extent unfair to them. We must, in due course, come to you, as we did last year, and state the case for an increase in the scale of compensation that we can offer these people as some inducement, not competitive with industry, but some inducement, to alleviate the situation in which they find themselves today.

Representative PRICE. I know many on the committee will be sympathetic with your request.

Mr. STRAUSS. We are glad to hear it.

Representative PRICE. And I think you also agree with me that this matter of shortage of scientific and technological manpower in the country is getting to be more serious day by day.

Mr. STRAUSS. We have been doing—or the Commission, from practically the date of its inception, has been doing something to alleviate it, but obviously it is not our field. We could not attempt, within the responsibility that we have under the act, or with the appropriation that we have, to take over so great a program. We have pointed it out, and most of us have devoted a good deal of time in talking about it, publicly and privately, and the fault lies as nearly as we can make out at the secondary-school level where not enough instruction is available in not enough schools of the country to provide candidates, qualified in chemistry, physics, and mathematics for the graduate colleges—that is, undergraduate colleges.

Representative PRICE. We are certainly glad to have your comment on that, because I have caused to be prepared, with the cooperation of the Legislative Reference Service of the Library of Congress, and on research of my own and some of my staff, a document on the subject of engineering and scientific manpower, which I am going to ask the Congress to make a public document. It goes into great detail on the subject matter which you have just been discussing.

Mr. STRAUSS. I would like to send you a copy of an address that Dr. Libby has made and two that I have made on the subject, which may provide you with some statistics of value.

Representative PRICE. I would like to have them; I probably have them incorporated in some of the statistics in this research, but I would still like to have the copies of the speeches of Dr. Libby and yourself. Thank you very much.

(The speeches referred to follow:)

FREEDOM'S NEED FOR THE TRAINED MAN

Remarks prepared by Lewis L. Strauss, Chairman, United States Atomic Energy Commission, for delivery to Sixth Thomas Alva Edison Foundation Institute, Hotel Surburban, East Orange, N. J., Monday, November 21, 1955

"* * * ourselves and children have lost, or do not learn for want of time, the sciences that should become our country."

—*Shakespeare (Henry V).*

If there is to be another war among the great nations of the world before the human race discovers a method of abolishing recourse to combat, that war may be survived by the country with the greatest stockpile of nuclear weapons and instruments of their delivery. But such a war will almost certainly be lost by the country with the fewest resources in trained manpower.

This is a conclusion which has been reinforced for me by experiences during the past 15 years, first with the research activities of the Navy and later with the Atomic Energy Commission. In the latter area, there are three components

necessary to success in meeting our established objectives. These are, first, the elemental raw material, second, the required funds, and third, human skill and intelligence.

Early in the work of the Commission, it looked as though the raw material would be a limiting factor. Most of our uranium was mined in Africa. By setting incentive prices which vigorously stimulated exploration and prospecting all over the world (and especially within our own borders) we have stepped up the production of this vital material to a point literally undreamed of 10 years ago.

The second requirement—money—has never been denied to the enterprise by the Congress. The appropriation of money is an expression of the degree of the concern and interest of the American people—their concern with their security and defense, and their interest in supporting discovery—a national characteristic since the earliest settlers reached our shores.

The third and indispensable component of success obviously is gray matter. Here, also, we have been fortunate, until now. But while we can look ahead and see no indications of dearth in raw material or means, the prospect for trained minds is a very different and gloomy one. Deposits of uranium can be located, opened, mined, and converted into metal in a very short time. Appropriations can be voted quickly whenever the Congress decides them warranted. But men and women cannot be qualified in disciplines so exacting as modern science without a dedicatory period—an apprenticeship—of years.

If you are concerned with the reasons for apprehension that this third component of progress and defense is in any way endangered—and I believe that it is—then this occasion associated with the memory of Thomas Alva Edison, the possessor of a self-trained mind—and therefore one of the great and unique exceptions—seems an appropriate opportunity to discuss the facts.

The recent Conference in Geneva on the Peaceful Uses of Atomic Energy produced a number of notable results, which was perhaps to be expected since it was the greatest scientific gathering ever convened. Some of these results already are evident; others will materialize as new inventions and refinements in many facets of the nuclear art bear fruit from the cross-fertilization of Geneva.

An immediate result was that we learned much about the quality of Soviet science, in terms of both the individual and the products of his talents. And what we learned was sufficient to shatter any complacency we may have enjoyed in regard to our own imagination and ability. Too many of us have fallen into the easy attitude of assuming that the Russians, because of what we have observed of the sinister purposes and slave methods of their political system and the compartmentalization of their research, could never match us in scientific initiative and progress.

This was dangerous self-delusion. Actually, the emphasis which the Soviets are placing on science and particularly on the training of new young scientists and engineers, presents a real and growing challenge to us, and to the free world.

Today their technical schools and universities are turning out scinetists and engineers who are well-trained and highly competent. Since Geneva we know this. The quality may differ from field to field, but generally speaking, their first-rank men appear to be as good as our own.

The Soviet challenge is not one of technological quality so much as numbers. It is evident that we are rapidly falling behind Soviet Russia in the training of engineers and scientists. The level of our reservoir of trained brainpower is dropping, in relation to the demand. They, on the other hand, are striving to fill their to capacity as rapidly as they can.

The facts and figures speak for themselves and they are not pleasant facts and figures. I should say here that their absolute accuracy cannot be assured, which is the case with most data from the dark side of the Iron Curtain, but they deserve and demand the prompt attention of every one who is interested in the continuation of our prosperity and in preserving our security and in maintaining peace.

We do know with certainty that we are turning out less than one-half the number of scientists and engineers we require—an alarming statistic by itself. You may have noticed that, each Sunday, from 6 to 10 pages of the metropolitan press are filled with advertisements attempting to enlist scientists and engineers to fill waiting jobs. These advertisers are for the most part the industries to which we look for the tools and weapons of our defense.

Inevitably our shortage of scientific manpower will become worse before we can do anything to correct it. This is an inescapable fact.

At present, we are about even with, or perhaps slightly ahead of the Soviets in numbers of trained scientists and engineers—about 1 million in each country and,

in Russia's case, for an industrial establishment far smaller than ours. At the moment we probably have more topnotch men than they have, since about half of those presently at work in the Soviet Union were trained under inferior prewar standards. However, last year Russia is estimated to have produced as many doctors of science as we did.

Russia has some 520,000 graduate engineers, and we may be sure that substantially all of them are engaged upon the work for which they were schooled. We presently have a somewhat larger number of graduates, but this is more than offset by the fact that only 65 percent of our engineers are actually working at their professions. A third of them have gone into executive jobs, or have wandered off into sales promotion, finance, and other lines of work.

We require from 45,000 to 50,000 new trained engineers every year. We are getting half that number. Last June's crop was around 23,000. Russia at the same time, produced 53,000 new engineers and is expected to substantially increase that number next year and each year thereafter. She is graduating 120,000 new scientists and engineers of all types this year, which compares with our total of 70,000 graduates.

Between 1950 and 1960, which may be the most critical decade of our national existence, Russia is expected to produce 1,200,000 trained engineers and scientists, against our 900,000.

In the face of figures such as these, we cannot take refuge in thinking that this Soviet crop is of an inferior, mass-production grade, or that they cannot maintain their high rate of output.

The fact is that the sciences have an overriding priority in Russian education. More than half of all Russian university graduates are in the science-mathematics fields; only one-fifth of our graduates are in those fields. Russian Ph. D.'s, or the equivalent, are three to one in favor of science and engineering; in the United States the ratio is just the reverse—nearly three doctorates in the humanities for every one in science and mathematics.

Where is the answer to this challenge to be found? Where are we to obtain the trained men to replace the present personnel in our laboratories and science faculties and industries as they retire or pass away, and to fill the expanding demand in every field for more and more scientifically trained people? The trouble does not rest, I think, at the end of the line of training, that is to say in our colleges and universities. They cannot create the candidates for these posts without the human material to start with. The difficulty lies more deeply in our educational system. Our graduate institutions cannot supply the scientists and engineers we need, if sudents do not come to them, ambitious to be scientists and engineers and possessed of adequate high-school preparation for such careers. The decisions that produce our skilled scientists and technicians are made, in the main, before they arrive on the college campuses.

Only about 16 percent of the high-school graduates entering college last year enrolled in engineering courses—or about 66,000 of them. That is not an entirely gloomy statistic, because the ratio has been going up, slowly but steadily, since 1950 and is expected to hold fairly steady around that 16 percent for several years to come. However, this must not be construed to mean that we will have 66,000 or more graduate engineers each year. Attrition, on the basis of our experience, will take a heavy toll. More than half of these 66,000 young hopefuls will flunk out along the way, or switch to other, easier courses. Ask the deans of our engineering schools for the reason and a composite of their answer is: Poor high-school preparation in science and mathematics.

Our high school systems—or, to be more accurate, you and I—are failing in our obligation to our national welfare and security. We fail when we squander the most valuable of our natural resources. Our youth is not being exposed to the excitement and challenges of science. We are not equipping the growing generation to protect or even to fully enjoy their modern heritage.

Large numbers of our high-school students have no opportunity to discover whether science and engineering appeals to them, because preparatory courses are not available, or—when such courses do exist—they often are taught by instructors who double in science, but whose interests lie in other subjects.

A recent survey indicates that from 250,000 to 400,000 high-school students in our country presently are learning mathematics from teachers not trained to teach it, and the same situation prevails in science teaching. Government figures show that part-time science teachers in our schools outnumber full-time science teachers.

Since there are not enough trained teachers to go around, the alternative becomes one of using unqualified teachers, or abandoning those courses. In an

appalling percentage of instances, as I shall cite in a moment, the courses have been abandoned.

The problem becomes a chain reaction in reverse, because fewer and fewer high-school courses in math and science mean fewer and fewer college students of science and engineering, and fewer graduates. And fewer graduates mean fewer persons with either the inclination or equipment to teach science and mathematics in the high schools. Thus, the teacher shortage grows progressively worse.

A graduate scientist or engineer cannot reasonably be expected to choose a teaching career at a salary so low that he may be compelled to take an afterhours job, often of a menial nature, to even make ends meet, when he has the option of a number of better paying jobs elsewhere. This has made it easy for industry to attract the people who would be science teachers, and thus the seed-corn is eaten up with no concern for the future.

Our high-school enrollments are growing but there are fewer college graduates to teach them. The number of qualified teachers of science and mathematics has fallen off about 53 percent in the past 5 years while the high-school student body has increased 16 percent and continues to go up.

The figure which I have cited of a 53-percent drop in the number of qualified math and science teachers, in reality, is a sugar-coated one, because not more than half of the men and women who leave college qualified to teach those subjects ever find their way into a high-school classroom. For example, of the 1954 college graduates qualified to teach chemistry, about 36 percent actually did so. What happened to the others? The explanation is the familiar one—better paying jobs in other lines of work.

One needs no more than these few statistics to see that our supply of scientific and technical manpower is withering at its source, in the high schools, for want of nourishment, while the Soviets assiduously cultivate ever-larger numbers at the same level.

In Russian high schools, of the study courses which every student must take, 40 percent are in science and mathematics. I am told, furthermore, that young Ivan is made to work much harder than our Johnny; he goes to school 6 days a week and by the time he completes high school he has had 6 years of biology, 5 years of physics, 4 years of chemistry, and 4 years of mathematics, including trigonometry. I can learn of no public high school in our country where a student obtains so thorough a preparation in science and mathematics, even if he seeks it—even if he should be a potential Einstein, Edison, Fermi, or Bell.

If this were not sad enough, more than half (53 percent) of our high schools do not teach physics at all. In half of our schools students simply have no access to this subject which is so important to an understanding of the technological world in which they will spend their lives.

Half of our high schools do not teach chemistry.

Two generations ago, in 1890, 1 in every 5 high school students studied physics. Today it is only 1 out of every 22. More than half of all students back in those days studied algebra; now it is less than one-fourth. The study of chemistry has fallen off 30 percent. These are the statistics of the United States in the era of technology.

Let us look briefly at the situation that prevails in these high schools still struggling to maintain science and math courses.

A survey of 30 States showed that about 1,800 new mathematics teachers were urgently needed, but 700 of the positions had to be filled with unqualified persons, including instructors in such unrelated subjects as music, home economics and physical culture.

I sincerely hope that none of my remarks will be regarded by anyone as reflecting upon our high school teachers. They are devoted, underpaid and self-sacrificing people and we have too long taken advantage of their devotion. If the teacher of music, or the high school athletic instructor, is required to teach chemistry or mathematics because no qualified instructor can be obtained, the blame should attach to us, for allowing our educational system to fall into such a regrettable state.

Also, I have dwelt on the contrasts in our educational program and its result with that of Soviet Russia, but not in any sense to suggest that what the Soviets are doing contains a solution to our problem. Their system of regimentation and even enslavement of the individual as a pawn of the state is repugnant to us. Our solution will have to be an American solution, consonant with our traditions of freedom and the dignity of the individual.

First of all, we must in some manner insure that those students with demonstrated aptitudes receive the inspiration they deserve. This is a challenge to

parents, educators, industry, professional societies and for Government at the Federal, State and local levels. It should be a matter of national remorse that less than half of our brightest high school students—those in the top 20 percent of their classes—go on to college, and only 2 percent of those judged capable of earning Ph. D. degrees do so. We go to great lengths to conserve our forests and wildlife and waste the most valuable asset of all.

Clearly one corrective is money. With adequate funds teachers can be fairly compensated and their numbers thus increased as they become trained and available. But where are the funds to come from? The costs of our school system are only second to those of our defense establishment. It is, therefore, beyond expectation that private or institutional philanthropy could step into the breach.

Does this mean the Federal Government must intervene? Many think so. They hold that a crisis is in effect upon us. That it is vital to our defense to have trained men not only at the controls of our complex instruments of warning and war, but especially in the laboratories whence these devices are to come, and that since these men must as a prerequisite come out of our educational system, the system itself must be federally supported if support is wanting. This is a hard argument to combat. But the consequences of Federal support are unacceptable to those of us who would like to see our educational system continue free from dependence upon Federal subsidy and from the interference and perhaps control which could follow the acceptance of such subsidy.

Many of us should be thinking of what might be done at once to begin to solve our problem. I have two proposals to advance—one immediate, the other a longer range action. Both are based upon the proposition that the public generally is unaware of the situation we face and will act intelligently, promptly and generously when it learns the facts.

For the short range I would propose that industry and the professional societies undertake through their organized bodies to popularize a plan whereby every engineer and scientist in the country would volunteer to conduct classes in physics, chemistry and mathematics in our secondary schools, for a few but certain number of hours each month during the school year. If this procedure were to be generously followed, the number of science-qualified entrants to our college system would make an appreciable change in the alarming figures now confronting us.

My second thought deals with the longer range problem, would be more difficult to organize, but might solve the problem once and for all. It is simply that the colleges should recognize the gravity of the threat we face and make a certain minimum of credits in physics and chemistry a requirement for enrollment. For instance, if such great associations as the American Council on Education, the Association of American Colleges, the Association of American Universities, and the Association of Land Grant Colleges and Universities were to consider and act favorably upon some such a proposition, we would see a great change in the curricula of the secondary schools. If their graduates had to have science to qualify for college admission, the local communities would insist that their school boards furnish it and if that meant paying a proper salary to science teachers to secure them, the means would be found. It is easy to demonstrate also that the costs at the local level will be less than if the funds have to be collected through Federal taxation and then fed back to the localities with all the cost of collection and Federal administration added.

These several suggestions will surely be inferior to others that will come from educators who are more conversant with the difficulties than a layman can possibly be. I can only hope that prompt thinking and effective action will be stimulated by what is being said on this subject by Dr. Waterman, Mr. Allen Dulles, and others who have been deeply concerned by the consequences of the situation in which we suddenly find ourselves.

The extent to which science has become a major factor in our living, our environment, and our fate is something now apparent to all who will examine the facts. Our position of eminence and influence in the world has been due to the prudent and vigorous applications of technology to the development of our resources and our industrial potential. It has been built on an educational system conducted by independent communities and, until recently, healthily concerned with the cultivation of the natural sciences and mathematics along with the humanities.

If we value these possessions which have made for our eminence and influence, we must be prepared to defend them. Our greatest possession, freedom, is itself partly the product of science, since it was technology which made slavery un-

profitable, and under freedom and only under freedom all our other treasures flourish.

It is a paradox that we should find ourselves at this point in history suddenly poorer in the very means by which our greatness was achieved.

This is the cold war of the classrooms.

In 5 years our lead in the training of scientists and engineers may be wiped out, and in 10 years we could be hopelessly outstripped. Unless immediate steps are taken to correct it, a situation, already dangerous, within less than a decade could become disastrous.

The Promises and Problems of Nuclear Power

Remarks prepared by Lewis L. Strauss, Chairman, United States Atomic Energy Commission for delivery to Case Institute of Technology, Cleveland, Ohio, November 9, 1955

I should like to speak to you this evening about a matter of important concern to all of us—the prospects for commercial nuclear power in the United States—and to offer an interim progress report on what is being done to produce from the atom electrical kilowatts which will be economically competitive with those obtained from conventional fuels.

I will try to outline what I believe to be a realistic appraisal of the situation, taking into account both the very great promise unfolded by the accomplishments thus far, and the technical difficulties which remain to be overcome, before nuclear power can pay its own way in the United States.

The recent Geneva Conference on the Peaceful Uses of Atomic Energy crystallized, as no other event had up to that time, the enthusiasm and optimism with with nations, great and small, look to the possibilities of nuclear power. In fact, the subject of electrical power generation from atomic energy was the topic of dominant interest among the delegates at Geneva.

Different countries are taking different paths toward their objectives. No one answer, or one set of answers, can serve or satisfy all of them.

For example, England has a strong incentive in that she foresees the end of her increasingly expensive coal. Much the same is true of other European countries. For such nations, the same degree of refinement of reactor technology which we must necessarily seek is not required to produce nuclear power which will be competitive with conventional plants. They cannot afford to wait on the technology.

In the United States, the development of competitive nuclear power has a more difficult road to travel. We face no urgent shortage of conventional fuels and more than 80 percent of our electricity is generated in large plants at a cost of 7 mills or less per kilowatt-hour. There are parts of Europe where nuclear power could be sold competitively today at a generating cost substantially higher than 7 mills, and in some areas of the world at even 3 or 4 times that figure.

What this means is that some countries—assuming competent scientists and engineers to do the job are available—have only half as far to go, or perhaps only one-third as far as we must go, to develop reactors which can turn out competitive kilowatts.

I have mentioned the fact that, because our reserves of fossil fuels are abundant by comparison with those of other industrial countries, we do not face the same urgency in getting atomic power into use. This is not to say, however, that for us no demand exists for atomic power

We need atomic power, not to supplant the conventional sources of electricity, but to supplement them, and thus keep up with our steadily mounting demand for electrical energy which has been doubling about every 10 years. We cannot afford to delay until the crisis is upon us.

The challenge is one, not merely of finding the means of producing electrical power from atomic energy which will equal the cost of conventionally generated power. We must seek further to reduce those costs.

If we could cut just one mill from today's average cost of producing a kilowatt-hour of electricity it would mean a saving of about $450 million a year to the national economy. In 1965, it might mean a saving of $1 billion or more.

Many technological difficulties must be surmounted before we attain all this, but even so we know, beyond any doubting, that commercial power from the atom is no mere dream of a dim and distant future.

It was only 13 years ago that Dr. Enrico Fermi and his small group of colleagues cautiously withdrew the control rods from the world's first nuclear

reactor and brought it up to a power level of two watts—just about enough to light a flashlight.

Today, nuclear power (at many tens of thousands of times that amount) drives the submarine *Nautilus* under the seas * * * power from a prototype reactor has flowed into homes, farms, and industries of upper New York State, another reactor has lighted the town of Arco, Idaho * * * our first central atomic power plant is being built in the Pittsburgh area, and other plants, even larger, will follow.

Under the original Atomic Energy Act of 1946, the development of the peaceful atom was established as a Government monopoly. There it remained, with only comparatively minor relaxations, until 15 months ago when the law was rewritten.

The Atomic Energy Act of 1954 continued to make our primary responsibility the defense of the national security through the development, manufacture, and testing of weapons, as well as the ownership and control of all fissionable material.

But, beyond this Commission responsibility for weapons, the gates were opened and American industry was invited into a closer cooperation with the Government for the development of atomic energy for the public good. The 1954 act marked a transition from a statutory Government monopoly to a regulated free enterprise industry.

The Commission is specifically enjoined from setting itself up in the nuclear power business. It is forbidden to produce and sell nuclear power, except when such power is a surplus byproduct, incidental to the operation of a reactor for research and development purposes or for the production of fissionable materials.

Nor may the Commission subsidize the building of nuclear power plants by private industries or publicly owned utilities, except to the extent that it may provide assistance in research work which will expand the fund of theoretical and practical knowledge and advance the nuclear art for the good of all.

It has neither the desire nor the intention to compete with private industry in the building of reactors, furnishing equipment, facilities, or materials, or of rendering technical services. It proposes to say out of such business whenever there is a commercial supplier available.

Even before the 1954 act became law, the Commission had taken steps to provide a greater role for industry, in the firm belief that no time should be lost in seeking the solution of economic nuclear power. To initiate the partnership, it established the 5-year power reactor program, calling for an outlay of more than $200 million of Government funds.

Under this program, we are building five experimental power reactors, each of basically different design, and each holding the promise of some day producing efficient and economic nuclear power. They comprise what might be described as a technological sweepstakes, without precedent.

The first large-scale, central nuclear powerplant in the United States—the pressurized water reactor being built at Shippingport, Pa.—is 1 of the 5 projects under this program, and the largest. This plant, although it will be delivering 60,000 kilowatts of commercial atomic power to the Pittsburgh area some time in 1957, is not expected to be economic. It is an experimental venture; it will provide technological and cost data which could be obtained in no other manner. The Duquesne Light Co. is performing a great public service by its part in this enterprise.

The 5-year program, however, was only the first step in the Commission's approach to the problem.

In January of this year, we took advantage of the provisions of the new act—then 4 months old—and initiated a second reactor-development program depending primarily on the ingenuity and competitive vitality of American industry. This was the power demonstration reactor program. Like the 5-year program it seeks to move us nearer to our national objective of competitive nuclear power. But whereas the costs of the reactors under the 5-year program are being borne almost entirely by the Government, the power-demonstration reactors are, to a substantial extent, financed by the risk capital of American business.

Industries, including both privately owned utilities and publicly owned power groups, are given the opportunity to build, own, and operate nuclear powerplants. To those willing to assume the major technical and financial responsibility for these experimental projects, the Commission offers several types of assistance, including, in some instances, Government funds to pay for research and development.

The Government's contributions are not, however, a subsidy for the building of nuclear powerplants. Instead, they are payments for technical and cost data resulting from both the construction and operation of those privately owned plants. Such data, once purchased with Government funds, becomes available to everybody.

It is the Commission's philosophy that the development of competitive power for civil use will be accelerated by the financial incentives common to the free-enterprise system. In this way can we best stimulate ingenuity, imagination, and the acceptance of calculated technical and economic risks. There is considerable inducement to industry to assume all the risks, without seeking any Government financial help. Two industrial groups already have chosen this course, even though they know, in advance, that the state of the art is still primitive. For one thing, a company or group which bears all the costs is entitled to retain all rights to any new discoveries or inventions accruing from its development and construction of a plant. It is not obligated to surrender them to the Government for public dissemination.

At the same time the Commission recognizes that success will come more surely and more quickly if there is the widest possible industrial participation in such a program. Had our program been set up without any provision for Government help we would be subject to just criticism on the ground that we were favoring the larger and richer companies and enabling them to get the inside track in this race for nuclear power.

The success of our initial invitation under the power-demonstration program is attested by the fact that industry quickly responded with 4 proposals, all for large central-station nuclear powerplants ranging in capacity from 75,000 to 180,000 kilowatts. The amount of Government assistance sought is comparatively small—on the average only 10 to 15 percent.

So clearly did the response to the first-round power demonstration invitations demonstrate the soundness of the program that on September 21 the Commission set in motion a second round, aimed particularly at encouraging proposals for smaller plants, of from 5,000- to 40,000-kilowatt capacities.

The Commission's reactor specialists believe that economic nuclear power will first be realized with large plants of 60,000-kilowatt capacities and upward. All of the first-round proposals were for large plants of 75,000 kilowatts and more.

However, there are many areas in this country where power is expensive and where the absence of heavy industrial and population concentration forbids the building of large-capacity nuclear plants. Additionally, such large plants would be of little use, and no doubt prohibitive in cost, for underdeveloped countries which will look to American industry to supply them with nuclear powerplants. That is why the second-round invitations have been directed to industries and groups interested in plants of the low-and intermediate-power ranges.

These smaller power reactors are designed to serve smaller areas, therefore they undoubtedly will be constructed by smaller groups or industries, and for this reason it may be necessary for the Government to pay for and retain title to all or a part of the reactor portion of the plant. Another factor bearing on the possibility of such Government payment is the fact, which I have already mentioned, that the economic risk appears to be greater in the construction of smaller plants.

Let me say, however, that we are hoping that it will not be necessary for the Commission to pay for and own any plant in entirety in order to advance the art even though we have thought it advisable to at least consider Government ownership in certain ranges.

Whatever the Government's assistance may be in any instance it will be closed-end assistance, that is to say, it will be a definite amount contracted for in advance as payment for technical and economic information to be produced.

The information paid for in this manner must, of course, be new information which will supplement existing knowledge, otherwise it cannot be said to contribute to the advancement of the art. This means that the Government, generally speaking, will not invest in projects which appear to duplicate each other. Under this philosophy the Commission could not justify giving financial assistance to research and development work on 2 or 3 reactors which are of the same type and size, and which, therefore, could be expected to produce the same or very similar data.

The "second round" invitation under the power demonstration program would seem to offer opportunities, not only to industries interested in perfecting the development of smaller power reactors for use here at home and for export,

but also to publicly owned power groups and cooperatives, many of which serve rural and small urban areas.

It is my personal belief that the time has come in the development of such small and intermediate-size power reactors to undertake the building of at least one such experimental plant which could be suitable for rural power cooperatives and for small towns.

Valuable spadework for such an undertaking already has been accomplished in development and research carried on in connection with the Commission's package power reactor for the Army. This project, although primarily military, is aimed at developing a small compact central station plant.

The Commission, in its program to promote the refinement of reactor technology, has no philosophy as regards the issue of public versus private power. The Atomic Energy Commission cannot give preference to either publicly owned or privately owned utilities, except in the sale of byproduct electrical power from the operation of a Commission-owned experimental or production reactor, and in certain instances of conflicting license applications. In such cases, public power companies or cooperatives were given a preferred position in the 1954 law.

The point is sometimes made that publicly owned power companies and cooperatives are placed at a disadvantage because they have no access to risk capital to invest in experimental power reactors, and that therefore the Government should abandon its closed-end or fixed contributions and share the risk with them, or perhaps even build the plants for them outright and charge it off to research. There are, however, very definite limits on how far the Commission can go in that direction.

A cooperative possessing limited funds for investment presumably would seek to build a power reactor of relatively proved technology, and therefore one less risky, from the standpoint of both construction and operation. Buch such a reactor might very well be the type in which the Commission would be least justified in making a substantial investment on the grounds of research and development.

The Commission obviously does not have the funds to build power reactors for every municipality and cooperative desiring one. It has no authority, and no mandate, to serve as a social and economic instrumentality in the distribution of nuclear power.

In closing, I should like to return for a moment to a phrase which I used repeatedly this evening—that is to say, "economic nuclear power."

We hear many estimates as to how soon nuclear power will become as cheap as that from conventional fuels. One recent survey by industry, for example, produced a forecast that more than $7½ billion will have been spent in this country on nuclear plants by 1965 and that large plants at least will be able to operate on an economic basis by that date.

I am optimistic that we will have economic nuclear power in the United States, possibly sooner than even the most optimistic of the prognosticators believe. There are areas of present-day research where breakthroughs could occur to upset all our calculations. There is both justification and need for optimism.

Nevertheless, we must not allow ourseles to be led into counting upon too much, too quickly. As a people, we are said to go to extremes, both in our exuberance and in our pessimism. I do recall that there were persons of considerable authority, at the beginning of this nuclear age, who were bearish for any early peaceful applications of atomic energy. In the same manner, there are presently those who look for nuclear energy to reach manhood without passing through the awkward period of adolescence.

We cannot now foresee what the future will bring, but we can have complete confidence that, with the empetus of traditional American incentives, no effort or opportunity will be overlooked to realize, as rapidly as possible, the tremendous potential of power from the atom.

Education and Atomic Energy

(Remarks prepared by Dr. Willard F. Libby, Commissioner, U. S. Atomic Energy Commission, for delivery at the National Education Association Convention for 1955, Chicago, Ill., Thursday, July 7, 1955)

In a sense, scientific inquiry is a normal function in human life. The professional scientist is a recent development. Leonardo da Vinci and Benjamin Franklin and many of the first scientists had important other activities. Perhaps the first man who discovered the method of making fire should be called a scientist.

We, therefore, are not surprised by the link we observe to exist between history and scientific development. We know the more dramatic effects of physical inquiry on human life, but large as the number of these is, there are many more small and incidental effects. We shall speak this morning principally of some of the developments in the sciences and some of their implications for education. As in times past, it has again become clear that the fundamental sciences are an inexhaustible source of human betterment. From them we derive laws and methods and tools useful and fundamental to the development of the applied sciences and ordinary life, and an understanding of nature essential to all of engineering and invention. And so without end, we cotinue to add to the list of benefits derived.

It is clear, therefore, that scientists are indispensable to modern life. We cannot understand how a leading nation can maintain its position without a strong scientific and engineering corps. It is obvious that in matters of armament and development of new processes, this statement is particularly true.

It is perhaps less obvious that the sciences constitute an important and possibly essential part of the modern educational discipline. It is difficult to understand just what the distinction between a scientist and anyone else is. Let us try to describe it, for in this way I think we may see that the study of the sciences is in itself an educational aim of some real value. First and most important in the scientific discipline is the requirement of humility on the part of the investigator—the requirement that he be willing to subject his conclusions and theories to experimental test and confirmation and to discard them or substitute them with new and better generalizations if the facts as disclosed by experiment do not conform with his predictions and conclusions. The scientist must be humble in this sense. He must be willing to change his mind and to move with the facts of nature. In fact, one might say that the scientist uses theories and generalizations mainly as a means of inspiring and promoting experimental research.

A second point is that the scientist must be a man very learned in the laws of nature. A vast literature, digested to a certain degree, but nevertheless large in volume, must be mastered. A large number of disciplines such as mathematics and the experimental techniques in chemistry and physics are indispensable. A long period of study and schooling and apprenticeship is required. Far beyond the period of conventional schooling when the digested material from the textbooks is learned, the scientist must proceed to practice a type of apprenticeship until the true significance and meaning of such varities as the laws of thermodynamics are borne in upon him, until he becomes a useful and independent practitioner. It is, of course, unrealistic to expect that the average person study science to the extent required for the scientist, but a knowledge of mathematics and physics and chemistry and biology gained in high school and college will help a person to assume an essentially scientific attitude in his daily life and in the ordinary observations of physical facts and phenomena. Such observations will teach him there is little use—in fact, nothing but death and defeat in struggling against the laws of nature. Laws of nature are not to be debated—they are to be discovered and to be obeyed without exception. This type of understanding is something derivable from none of the other disciplines. The knowledge of the sciences gainable in school is in itself useful, of course, in that many facts of ordinary life are better understood and many ordinary decisions are better made with this knowledge. Understanding of the laws of thermodynamics, the chemical characteristics of the elements, or the physical principles underlying the transmission of light and radio waves is helpful in ordinary life.

We can hope, therefore, that the sciences will be taught as subjects worthy of study themselves and, of course, they have been so taught in this way for generations. The particular point I wish to make this morning is that for some reason or reasons they are not as popular in a relative sense as they were a few years ago. I would like to discuss with you the importance of reversing this trend, and some methods which might be used to do so.

In the most dramatic of the recent developments in the physical sciences—atomic energy—the whole principal part of the accomplishments has been directly due to scientists and engineers. In this development and throughout the industrial life of the Nation, the shortage of adequately trained scientists and engineers is a matter of serious concern. The shortage is endangering the national security in a vital sense because our industrial strength is dependent on scientific and engineering fields. Our supremacy in advanced military technology is threatened and the shortages are actually greatest in those specialities

most important to national defense. Furthermore, the change tends to be self-perpetuating and the secondary schools cannot obtain qualified science and mathematics teachers for even the present requirements, let alone for the foreseeable growth in the future. About 80 percent of our high-school graduates do not receive bachelor degrees, and only about 2 percent of those judged mentally capable of obtaining Ph.D. degrees in any field, do so. Our concern for science and engineering does not in any way reflect upon the essentiality of other professions or occupations. It is, however, the field of science and engineering in which we are confronted with a shortage that must most immediately concern us.

We have to try to understand how this shortage has come about as well as its seriousness. It seems clear that among the causes is the inadequacy of the salaries for high school teachers, and the consequent inadequacies in the offerings in the high-school curricula. These salaries must be increased significantly. In addition, one realizes that the colleges and universities have sometimes done an inadequate job of instruction. The type of people who can successfully pursue a career in the scientific and engineering fields have many doors open to them, and the competition in the freshmen and sophomore years in the colleges and universities for their interest is acute.

There are other probable contributing causes to the shortage. The scientific fields themselves have a tendency to change rapidly in the sense of their newness. It is characteristic of the research man tha the is interested in the newest fields, and it is also true at the university level that the research man is frequently the most interesting and effective teacher in the scientific field. It is to be hoped that the continual discovery of new applications and new aspects of the sciences and engineering will keep them in a condition of glittering freshness which will prove to be sufficiently attractive. This recasting and redescription is in itself an important task of the good teacher. He can and does utilize the newest developments in science to demonstrate the freshness and vitality of the sciences. For example, a high-school chemistry teacher might well use radioactive isotopes in his classroom and laboratory in small and safe amounts for this purpose. There is an isotope of calcium which is particularly useful in the study of the chemistry of this element. Similarly, a very useful isotope of sulfur exists, and there is, of course, an extremely important and useful isotope of carbon. He should select a few of these and incorporate them in the ordinary chemical forms and place them on his reagent shelves in the classroom near an appropriate counter apparatus. In this way, he would undoubtedly greatly stimulate the interest of the better students and perhaps encourage them to enroll in the subject. The AEC stands ready to assist in any such uses of radioactive isotopes in teaching and, in fact, in any other reasonable way which anyone can suggest.

We must improve the teaching of science and mathematics in the high schools by providing a larger number of qualified teachers, better teaching aids, and consolidating schools to permit more courses, etc. We must improve at the high school level the identification, motivation, and guidance of capable students toward careers in science and engineering. Also, we must increase the number of qualified students who go to college, and encourage those with scientific and engineering aptitudes to pursue the courses in science and engineering. We must develop the necessary incentives to retain highly gifted scientists and engineers in colleges and universities. Finally, in addition, we should consider the improved utilization of scientists and engineers by providing additional technical personnel to relieve them of subprofessional assignments.

It appears that the responsibility for these necessary changes rests primarily with the leaders in the universities, colleges, and high schools in the general fields of education, as well as with the scientific and engineering professions in industry and labor. The acuteness of the problem is widely recognized but it is not clear that the methods of solving it are generally known and accepted. It is so very difficult to believe that a small group of people can be so vitally important. Of course, we have learned this lesson with medical doctors, although I understand there are shortages in some parts of this field now also.

The relative importance of the instructions in the various sciences is not clear but, fundamental to all the sciences, of course, is mathematics. The foundation for mathematics must be laid in the high school. It seems clear that if a student avoids mathematics in high school, the chances of his pursuing a scientific or technical course in college are extremely small. It is very important, therefore, that mathematics be taught to the maximum number of people qualified.

As you all know so very well, the problem of the superior student is an extremely difficult one. However, it is, I am certain you will agree, to the superior

students that we must look for the future scientists and engineers. I must therefore suggest that it is very important that adequate attention always be paid to this small but important fraction of the classes in mathematics and the sciences in high school. In many instances, only inspirational teaching will suffice. Nothing short of an attitude of this sort will excite and maintain their interest. Particular attention has to be given to their idiosyncrasies, and particular care to avoid discouragement is extremely important. It is, of course, not necessary to tell you these things but I think that we should periodically remind ourselves of these eternal truths and facts. I want to assure you that there is no more important service to the Nation which you could now perform than to save and nurture for the future the prospective scientists and engineers who pass through your classrooms.

These men and women are people who will protect our physical well-being, will continue to supply the new developments on which our society thrives, will bring to us such benefits as atomic power and the other peaceful applications of atomic energy, and will continue to serve as an example of a type and method of thought somewhat freer of the effect of human frailties in that they will show that clinging to the eternal verities is a constant way to material welfare.

I do not intend in any way to deprecate the importance of the nonscientific subjects nor to detract from their emphasis. It seems clear to me that there is room for all and that we are desperately in need of a general affirmation of the importance of high school and college teaching in general, and a strengthening of our educational system.

Let us place ourselves in the position of the college freshman student, answering the momentous questions which will determine the nature of his career. Suppose further that there had been no inadequacies in his early training, so he has come to college fully equipped with a mathematical background and with a full complement of high school science courses. Now, should he become a scientist or engineer, or should he become a businessman or lawyer? It is clear on the one hand that the chances of attaining a large income would be much better for a businessman or lawyer than for a technical man. He must, therefore, if he chooses to become a technical man, do it on nonfinancial grounds. There seem to be two principal considerations which would lead him toward the technical life. These are: The desire to discover, which characterizes the research man, and the desire to serve mankind. Of course, the latter purely altruistic motivation which, by the way, is of course not restricted to technical men by any means, is a strong one, but probably the most effective motivation is the first one—the urge to do research and to discover new knowledge.

It is clear, therefore, that a science which is approaching maturity so that the rate of discovery is reduced, is threatened with a shortage of recruits. I believe that at the present time a part of the shortage of scientists is due to a misunderstanding that this situation applies to the fundamental sciences right now. I believe that this misconception must be dispelled, and that the potential students must be told that the great discoveries which have been made in the last 3 or 4 decades have by no means exhausted the possibilities, and that the next years hold promise of equally important ones. It is this promise which leads students into science. We probably are right in thinking of science as having an essentially endless frontier. We have no signs of its exhaustion as a whole, although particular fields and aspects have proven in the past to have been completely explored.

For example, in chemistry we can cite a probably rich new field in the chemistry of large molecules, that is, the chemistry involved in living systems and in solid state reactions; while, in physics, the understanding of nuclear forces about to be derived from the investigation of the ephemeral mesonic particles produced by the cosmic rays and the most energetic of modern accelerators will constitute a new and abundant source of discoveries of the greatest practical, as well as theoretical, importance. We must tell the students that new things are about to be found and we want them to help us find them. We should reiterate the importance of the technical man to our material well being and, with no thought of detracting from other fields of knowledge, point to the virility and reality and significance of the technical man's life. In this way, perhaps our wondering freshman can be persuaded to choose a scientific career.

Without in any way depreciating the important need to strengthen the teaching of science in the secondary schools as the main step in promoting the pursuit of science among our citizens I would add that that is not enough. If we are to hold our lead as a nation in scientific achievement, we must also provide the tools for research in the fields of science which seem ready to yield to the

most rapid advances. The opportunity to explore these fields is the attracting force which draws the student into a scientific career and provides the stimulus to make his studies productive.

The story of the rise of nuclear physics is a familiar example of a challenging problem, the study of which was implemented at a crucial time by the invention of the cyclotron and other electronuclear devices. The opportunity to make the studies attracted the manpower and resulted in a scientific force which was able to push through to the successful release of atomic energy and to raise the curtain on a new industrial era.

Recently we have witnessed the dawn rising over a new field of science—that of the meson and nucleon. What we will find there, no one can guess, but it involves the most basic properties of all matter. It challenges the imagination of our best scientists and if tools are provided for its exploration it will attract many of our most gifted youths into scientific pursuits. Unfortunately the tools for research in this field are expensive. They include huge accelerators like the cosmotron at Brookhaven which gives nuclear particles with energies of 3-billion electron volts and the 6 billion volt bevatron at the University of California. These machines cost several million dollars each—too much to be provided by private contribution.

In order to place tools of this kind in the hands of oncoming scientific generations, the Commission requested from Congress in the budget for the present fiscal year funds for two accelerators capable of explorations in this new field of science. These machines will be placed at university sites where they will be most effective in stimulating teaching and research. The sites will be selected from those expressing an interest on the basis of the expected contributions to science and the scientific strength of the Nation taking into consideration the characteristics of the proposed designs, the scientific interests and capability of the staff, the accessibility of the site to an adequate force of scientific manpower, and the contributions the proposing institution would make in other facilities and funds toward a successful program.

Representative DURHAM. Before we go on to the next section, we have with us this morning our new Commissioner, Mr. Vance, whom we welcome and we are glad to have you with us, Mr. Vance. This is your first visit with us and we are very glad to have you.

Mr. VANCE. Thank you, Mr. Durham.

Representative DURHAM. Now, it is almost time for the House to meet, and we will meet again at 2 o'clock, and before going into this other matter, which I think is highly important—because this is practically all new material that we are all highly interested in, and to give it full value, I think that we should take it up at the 2 o'clock meeting.

(Whereupon, at 12 noon, the joint committee recessed to reconvene at 2 p. m., of this same day.)

AFTERNOON SESSION

Representative DURHAM. The committee will come to order.

I believe the section now we shall take up, Mr. Strauss, is the section in the program to encourage private enterprise.

Mr. STRAUSS. Mr. Chairman, may I ask whether I would have your permission to be personally excused at 3:30? I have an appointment with the President, and Dr. Libby will remain.

Representative DURHAM. Of course, you may be excused any time you wish. Who is presenting the next paper?

Mr. FIELDS. I will, Mr. Durham.

This section has to do with the program to encourage private enterprise. In accordance with the policies established in the Atomic Energy Act of 1954, the Commission has initiated measures on a broad front to encourage the entry of private enterprise into atomic energy development. A primary step in this program is the dissemination

to industry of information about the basic science, technology, and economics of the atomic industry as it stands now and as it may develop in future years.

We are therefore first summarizing the various steps that have been taken to make both unclassified and classified information available to American industry. This involves several operations by the Commission: Declassification or downgrading—that is, lowering the classification—of technical information; publishing and distributing information so that it is readily available to users; providing access to classified information; arranging for seminars, visits, and interviews by the representatives of industrial firms with AEC and contractors' specialists in industrial atomic energy.

Besides action to provide information, the Commission has encouraged industry to build full-scale powerplants in order to hasten the day of economic nuclear power. The Commission has offered certain assistance under the power demonstration reactor program and the results of this program to date are reported in this section. The Commission has also encouraged industry to build other industrial plants that will provide services and supply to fill new requirements of the Government atomic energy program and the developing of private atomic energy industry.

Up to this time the provision of these services and supply has been solely in the hands of the contractors to the Commission. Most of them operated Government plants and were reimbursed their costs and paid a fee for their management. What is going on now is a deliberate, determined attempt by the AEC to avoid wherever possible further extension of Government ownership and operation of facilities and to encourage the entrance of private investment all along the line into such matters as fuel element fabrication, chemical processing of spent fuel elements from reactors, provision of the feed materials for the industry, et cetera.

In reporting the Commission's policies and its actions designed to encourage private enterprise, we propose to start with a review of what has been done to enlarge and support the dissemination of information on industrial uses of atomic energy.

Dissemination of information. A large volume of the information of use in peaceful applications of atomic energy is unclassified and available to all. However, certain information necessary to peaceful atomic energy development is still classified. Therefore, to encourage widespread participation in atomic energy development for peaceful purposes it is also necessary to find ways of making certain classified information available under security safeguards.

The Atomic Energy Act of 1954 carries new provisions regarding restricted data which have encouraged Commission action to enlarge the availability of industrial information. These actions have included (1) liberalized and expedited declassification of useful information, (2) the lowering of classification of a substantial amount of data to make it confidential restricted data, (3) providing under necessary safeguards readier access to restricted data relating to peaceful applications of atomic energy.

I now describe the present availability to industry of unclassified information on atomic energy, the progress made in declassifying information or downgrading it to confidential, and the status of the

program for providing access to both classified and unclassified information useful in atomic energy development for peaceful purposes.

Unclassified information available for industry: From the beginning, the Commission has maintained a comprehensive system for making unclassified information coming out of the program available for all who could use it. Heavy reliance has been placed upon publication in the scientific, engineering, and industrial information journals of the Nation of technical reports on work completed or in progress. Those reports not published in the journals but, nevertheless, of sufficient interest to warrant publication are issued by the Commission. This has constituted a considerable publishing program.

In addition to issuing the individual reports, the Commission also has carried on a system of preparing and publishing compilations of information applying to individual fields of work and development. An example is the three-volume Reactor Handbook giving much of the unclassified knowledge available in the field of reactor development.

To assist users in locating the items of the literature published both by the journals and the Commission, an unclassified biweekly abstract journal Nuclear Science Abstracts is published. Bibliographies are also compiled to guide the user to the literature available in the field of his interest. The abstract journals, the biblographies and the AEC-published reports are on sale to the public.

So that interested persons may examine literature and readily find out what would be of most use to them, the Commission has designated 47 libraries as depositories and has supplied them with complete files of the Commission-published unclassified reports and compilations and of the abstract journals and bibliographies. At four of these libraries, unclassified engineering drawings also are available for inspection. Reference and photostat copy service on all of the AEC unclassified reports is available to industry and the general public at each of the 47 libraries.

Representative DURHAM. Mr. Chairman, at that point, I would like to ask a question. Would it be possible to furnish a list of those for the record?

Mr. FIELDS. It would be.

Representative DURHAM. I think that would be well for the record.

Chairman ANDERSON. Would you supply that for the record, then?

Mr. FIELDS. I will do that, Mr. Chairman.

(The information referred to follows:)

UNITED STATES ATOMIC ENERGY COMMISSION UNCLASSIFIED DEPOSITORY LIBRARIES AS OF FEBRUARY 1, 1956

California:
- Berkeley, University of California General Library
- Los Angeles, University of California Library
- Menlo Park, Stanford Research Institute [1]

Colorado: Denver, Denver Public Library
Connecticut: New Haven, Yale University Library
District of Columbia: Washington, Library of Congress
Florida: Gainesville, University of Florida Library
Georgia: Atlanta, Georgia Institute of Technology Library [1]
Illinois:
- Chicago, John Crerar Library [1]
- Chicago, University of Chicago Library
- Urbana, University of Illinois Library

[1] Supplies engineering drawings as well as documents.

Indiana: Lafayette, Purdue University Library
Iowa: Ames, Iowa State College Library
Kentucky: Lexington, University of Kentucky Library
Louisiana: Baton Rouge, Louisiana State University Library
Massachusetts:
Cambridge, Harvard University Library
Cambridge, Massachusetts Institute of Technology Library
Michigan:
Ann Arbor, University of Michigan Library
Detroit, Detroit Public Library
Minnesota: Minneapolis, University of Minnesota Library
Missouri:
Kansas City, Linda Hall Library
St. Louis, Washington University Library
New Jersey: Princeton, Princeton University Library
New Mexico: Albuquerque, University of New Mexico Library
New York:
Buffalo, Lockwood Memorial Library
Ithaca, Cornell University Library
New York, Atomic Industrial Forum
New York, Columbia University Library
New York, New York Public Library
Troy, Rensselaer Polytechnic Institute
North Carolina:
Durham, Duke University Library
Raleigh, North Carolina State College Library
Ohio:
Cincinnati, University of Cincinnati Library
Cleveland, Cleveland Public Library
Columbus, Ohio State University Library
Toledo, University of Toledo Library
Oklahoma: Stillwater, Oklahoma Agricultural and Mechanical College Library
Oregon: Corvallis, Oregon State College Library
Pennsylvania:
Philadelphia, University of Pennsylvania Library
Pittsburgh, Carnegie Library of Pittsburgh
University Park, Pennsylvania State University
Tennessee:
Knoxvillle, University of Tennessee Library
Nashville, Joint University Libraries
Texas: Austin, University of Texas Library
Utah: Salt Lake City, University of Utah Library
Washington: Seattle, University of Washington Library
Wisconsin: Madison, University of Wisconsin Library

Mr. FIELDS. The volume of available literature has been greatly expanded and aids to its use have been improved during the past year. The expansion continues at a growing rate. At present there are about 16,000 technical reports available for industry, including 1,200 Geneva Conference papers. Of these 16,000, some 6,000 may be found in the scientific and engineering journals and the remaining 10,000 may be purchased from sales outlets established by the Commission to promote the widespread dissemination of its unclassified information which has not been published in the technical journals. In addition to the individual reports, there are 200 compilations and summaries available on sale.

Sale of unclassified reports. Copies of all AEC unclassified technical reports may be purchased from the Office of Technical Services, Department of Commerce. Some 2,500 of the reports judged to be most useful are currently available in full-size copies and all other reports are made available in photostat or microfilm form as rapidly as they are declassified or are issued by the Commission. An indication of the increased public demand for AEC reports is shown by

the growth in the monthly sales volume recorded by the Office of Technical Services. Sales increased from about 2,500 copies in January 1954 to about 7,500 copies in January 1955, to around 10,800 copies in November 1955.

Representative DURHAM. May I ask, what are the sales outlets?

Mr. FIELDS. The sales outlet is the Office of Technical Services, Department of Commerce.

Representative DURHAM. How about the paragraph before that, where you mentioned the sales outlets? Do you use the same service for both?

Mr. FIELDS. We use the same service for both, and we do sell some from the Technical Information Services at Oak Ridge, sir.

Chairman ANDERSON. Will you proceed, Mr. Fields.

Mr. FIELDS. All unclassified AEC technical reports are now available for sale in microcard form from the Microcard Foundation, Madison, Wis. The Commission has recently completed arrangements with two other microcopy manufacturers to sell AEC unclassified reports in microcard or microprint form. These companies are Clarke, Hitchcock & Associates, Washington, D. C., and Readex Microprint Corp., New York.

Copies of all AEC special handbooks, compilations, study team reports, and booklets printed at the Government Printing Office are put on sale by the Superintendent of Documents.

Representative COLE. May I inquire of General Fields in connection with these microreproduction contracts, does the Commission have any control over the price charged by the printing companies for their product?

Mr. FIELDS. Let me check into that. We have an arrangement with them under which they charge minimum costs, and I understand it is a nonprofit arrangement.

Representative COLE. Is that true with respect to all of these three institutions or companies, the Microcard Foundation, and the Clarke, Hitchcock, and Readex Microform?

Mr. FIELDS. Yes, sir.

Representative COLE. They are all nonprofit corporations?

Mr. SALISBURY. Microcard is a nonprofit corporation and the other two are profit, but they have to meet Microcard prices.

Representative COLE. Do they duplicate, all three of them, the same information?

Mr. SALISBURY. If a purchaser wants to get it. We simply provide the companies a file of our unclassified reports.

Representative COLE. Microcard does not limit itself to certain aspects of the unclassified information, and the other companies with a different aspect and the third to a still different one?

Mr. SALISBURY. No.

Representative COLE. All three cover substantially all of the unclassified reports.

Mr. SALISBURY. Yes, sir.

Representative COLE. And among two of them there is direct competition?

Mr. SALISBURY. That is true.

Representative COLE. And two of them must compete with the prices charged by the nonprofit institution.

Mr. SALISBURY. That is right.

Chairman ANDERSON. If Microcard is doing it on a nonprofit basis, why do these other companies that are trying to make a profit get into the business?

Mr. SALISBURY. They wanted to have a complete range of service for their customers, I suppose.

Chairman ANDERSON. Have you checked it at all to know whether there is a similarity of price?

Mr. SALISBURY. What is the question, please?

Chairman ANDERSON. Do you know whether the prices are comparable?

Mr. SALISBURY. Not recently.

Chairman ANDERSON. Have you ever?

Mr. SALISBURY. I think we did at the beginning.

Chairamn ANDERSON. Who checked them?

Mr. SALISBURY. Our Technical Information Service.

Chairman ANDERSON. What did they find?

Mr. SALISBURY. I will have to give that to you for the record. I do not have it in mind.

(The information referred to follows:)

COMPETITIVE PRICING ON SALE OF MICROCOPY

The sale of microcards of AEC reports began in 1954 when the AEC negotiated a contract with the Microcard Foundation of Madison, Wis., providing for the reproduction and sale of all existing AEC reports. AEC established a price schedule designed both to reimburse the Microcard Foundation for its expenses and to protect the public from excessive charges. At that time only one company was known to be interested in the sale of microcards and no information existed as to the possible volume of sales which might result.

In recent months when other organizations have indicated an interest in selling microcopies of Commission technical reports, the Commission offered to ented into a nonexclusive contract with any interested company. The fixed price for microcards provided for in the initial contract with the Microcard Foundation was eliminated with the view that competition among several sales outlets would establish a reasonable price level.

A price schedule has been issued by Clarke, Hitchcock, and Associates, 1 of the 2 companies which contracted to sell microcopies of reports. The price levels are generally comparable with those set by the Microcard Foundation. The Readex Micropoint Corp. has not yet issued a price schedule. The basic price schedule as issued by Clarke, Hitchcock, and Associates and the Microcard Foundation are:

(*a*) Clarke, Hitchcock, and Associates 35 cents per card (plus a charge of 75 cents for handling an order of less than 10 cards).

(*b*) Microcard Foundation, 50 cents per card.

It will be apparent that on anything except small orders of five cards or less, the Clarke, Hitchcock price is less than that of the Microcard Corp.

Representative DURHAM. For what reason did you not place it in the hands of the Superintendent of Documents as all of the other Government agencies do at the present time? You felt like you would get wider distribution by using more outlets? It is the usual procedure that all of this come through the Superintendent of Documents at the Government Printing Office.

Mr. SALISBURY. The Superintendent of Documents does not provide microcard or microfilm service. All of those publications that are issued at the Government Printing Office go on sale by him, but not the others.

Mr. FIELDS. Price lists of all Atomic Energy Commission reports and special publications are circulated free to all known to have an interest and are available on request from the Commission or from

the respective sales outlets. A copy of a brochure prepared by the Commission, entitled "What's Available in the Unclassified Atomic Energy Literature and Where You Find It," is also furnished to all who have evidenced interest in such information.

Recent progress in downgrading and declassification of industrial information:

The control of information is necessary to assist the military technology of the United States to stay ahead of our potential enemies and thus to protect the common defense and security. Also, as stated in the 1954 act:

> The dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide the free interchange of ideas and criticism which is essential to scientific and industrial progress and public understanding and to enlarge the fund of technical information.

The declassification of restricted data involves a balancing of these objectives.

Representative COLE. Now that we have been interrupting you as you have gone along, I would like to revert back to an earlier statement that you made, to the effect that certain information necessary to peaceful atomic energy development is still classified. Can you tell us in a general way the type of information which is necessary to the peaceful development of the atomic energy which must still be classified?

Mr. FIELDS. Yes, sir. There is information having to do with certain production technology that is common to production technology and reactor technology. There is similar information in the weapons field, and certain material characteristics and technology that is probably comparable. There is information on the propulsion units being developed in the military propulsion program that is common information, and then there is information on rates of progress and status that may become so.

Largely it has to do with technology of production reactors and technology or materials characteristics and information of this nature which may be common to weapons or military propulsion reactor programs, and peaceful reactor programs.

Representative COLE. In view of the fact that every reactor has some relationship to national security in that it produces the weapons material, I would assume that some of this information which you say still must be classified, even though it has a direct relationship to peacetime uses is classified because also it has an equally direct and perhaps preponderant relationship to weapons production.

Mr. FIELDS. That is correct.

Representative COLE. I am curious to know how it is that the Commission determines when that division line is reached, as between information that can be unclassified relating to a reactor, and information which must still be classified. Do you have any rule of thumb, or any yardstick or how does the Commission decide how far to go and no further in declassification?

Mr. FIELDS. We do not have a rule of thumb, and I believe the subject is complex and does bear on the security of the country to the extent that thorough reviews are necessary. Now, we are at the present time reviewing again our declassification guide in which these areas of classified information are described, and evaluating the sig-

nificance of certain parts of our information to the military program and to the peaceful uses program.

Representative COLE. Tell me briefly, what is the process of declassification? Who are selected as the ones to sit down and review that piece of paper to determine whether it can be published or not? What review is there of the decision of that declassifier, if any? What are your procedures for declassification?

Mr. FIELDS. The procedures are based, first, on a declassification guide that is comprehensive and covers all of the fields of information of atomic energy developed under Commission auspices. This guide sets forth the classifications that should hold for the different sorts of information. This guide is, as I say, constantly under review, and it is prepared through our Division of Classification, with the assistance of many technical and scientific personnel who work with us on this, including a committee of senior responsible reviewers. Now, given this guide, each of our contractors have classification personnel on their force, or their staff, who review documents in keeping with that guide. Eventually, when you come to the declassification of it, the Commission has personnel which take part in this review within the framework of the guide that has been approved. There are questions of interpretation that sometimes arise, and often these are referred to our Director of Classification in Washington for review.

Representative COLE. I would assume that in selecting your classifiers, the persons who classify, the Commission would have to be guided by three considerations with respect to the qualifications of the individual. One is his scientific competence, and the other would be—and a very important factor—his reliability.

Mr. FIELDS. That is correct.

Representative COLE. I have forgotten what the third one was that came to my mind but perhaps it is not important.

Representative PRICE. If the gentleman will yield, what good would the guide be if the paper does not come before the people who apply the guide?

Mr. FIELDS. I do not quite understand your question, sir.

Representative PRICE. You said that you had a certain rule of thumb, and a certain guide which indicated that certain people would establish the guide, but I did not see any connection between the people who establish the guide, and how you get the paper before them in order to apply the guide. Suppose it went through other hands?

Mr. FIELDS. Well, the guide is a rule book which is followed by all of our personnel, contractor as well as Commission, in classifying reports that they write to begin with. The act, itself, prescribes that all information will be restricted data, that is developed on the atomic energy program unless the Commissioner determines that it is not, and that it can be published, and so with this rule book in effect the persons, scientists, and others writing in the Commission, start from that and normally would have a classification review of any report that they write.

Representative COLE. How many reviewers of classification are there within the Commission?

Mr. FIELD. There is something over 100, of what we term "responsible reviewers."

Chairman ANDERSON. How many irresponsible?

Mr. FIELDS. That is a term of their level in the process. They are all responsible, sir.

Representative COLE. I thought that you means by "responsible reviewers," that there are 100 persons, one or more of whom must pass upon all of the decisions to declassify which have been made by the Commission.

Mr. FIELDS. That is correct.

Senator PASTORE. You mean "responsible" in the sense of qualified.

Mr. FIELDS. They are qualified and they are responsible in the process for the particular field of activity that they are in, and for the particular area in which they operate, that is, geographical or contractor area.

Senator PASTORE. May I ask a question along the lines that Congressman Cole has asked: When you get to this very sensitive area, where the line of demarcation becomes very thin as to whether or not the information might be of a military value, how do you at that point resolve the doubt that it should not be declassified, or that it should be? How do you resolve the doubt?

Chairman ANDERSON. If there is any question, you keep it classified. Is that not the general rule?

Mr. MARSHALL. That is not invariably true.

Mr. FIELDS. It varies.

Senator PASTORE. There has been so much talk about this—

Mr. FIELDS. If it is very sensitive information, I do not think that you have a thin line to walk on.

Senator PASTORE. Where, of course it is sensitive information, naturally, you would have no problem at all. I think that you have already said to Congressman Cole in answer to his question that there are times when the line becomes very, very thin and that is where I suppose reasonable men can disagree. What is the technique followed at that point? Do you take into account the fact that this information is generally known by other people or does that come into the element of decision, or what do you do?

Mr. FIELDS. That comes into the element of decision probably as largely as any of the other factors, but the guide is rather comprehensive. It does need interpretation, but I do not believe we have had too many difficulties with this interpretation.

Senator PASTORE. Would you say the line is never very thin, then?

Mr. MARSHALL. It is not often thin.

Mr. FIELDS. Could Mr. Marshall answer the question, please?

Representative COLE. Tell us who Mr. Marshall is and why he should answer.

Mr. FIELDS. He is the Director of our Division of Classification, and it would be more appropriate for him to reply.

Mr. MARSHALL. In the very, very few cases where the advantages of releasing information exactly balance the disadvantages, in other words, where the national security is exactly balanced against the advantages of release for some other reason, such as civilian application, we have used the principle that national security must weigh in the balance, and we keep that particular bit classified.

However, it has happened on very, very few occasions.

Senator PASTORE. The reason why I asked the question is this: I do not ask it for any frivolous reason. I have a serious reason for asking it. There has been much criticism of the Atomic Energy Commis-

sion, and I am not being critical now, that you have not declassified enough. I think that much of the criticism has come from people who, the chances are, do not have a good foundation in the background and the knowledge that is necessary in order to arrive at these conclusions.

Now, I should think that much of your trouble would be in this very sensitive area. I think it is easy to determine what should be declassified, and what should not be, where you do not reach this sensitive area, but when you get into the sensitive area you have a definite problem. That is what is military and what is not military. You get pretty close to that line, and then, of course, I think that you have a serious responsibility. Now, my question is, how do you resolve it at that point, and have you had many problems along that line?

Mr. MARSHALL. Well, again, at the point where we have an exact balancing of the one list of advantages against the possible damage to the national security, as I say, these have been very, very few, but in such cases the national security has weighed in the balance and we have kept such information classified. Now, in the fields, these sensitive fields that you are speaking of, where the advantages of release outweigh the disadvantages, we, of course, release it.

Senator PASTORE. Would you say that your activity within that region has deterred in any way a satisfactory or reasonable development of atomic energy for peacetime pursuits?

Mr. STRAUSS. I do not think so, Senator. We have had no specific indication to that effect. As a matter of fact, this year, this past year has brought for the first time not the hostile but nevertheless critical observation that we were releasing too much material.

Representative COLE. From whom?

Mr. STRAUSS. From a professor in one of the sciences in a southern university who made this critical comment in the course of an address before a congress of scientific and engineering bodies.

Representative COLE. If you will excuse me, was he concerned from the standpoint of national security?

Mr. STRAUSS. No; I think that the tenor of the criticism was rather directed to the fact that we were releasing so much stuff of this nature that we were flooding the market, so to speak.

Chairman ANDERSON. Did he not really say there was so much of it you could not digest it?

Mr. STRAUSS. Of course, Senator, the attempt to make these abstracts available which the Commission has been doing now for years is aimed at facilitating the search for information that is particularly interesting to an individual research man so that he does not have to winnow through an enormous amount of material to find the information and papers that are of specific concern to him.

This is the first time we have been accused of putting out too much.

Mr. FIELDS. May I return to the other point, the weighing that takes place in instances of the value of peaceful uses against the danger to national defense, in the revelation of information?

The principal time in which this really is prominent in the thinking, and when these questions are weighed, is when the Commission approves the declassification guides. Largely in the particular areas themselves there are a great deal of specifics, so that there is not too

great a latitude for interpretation. This balancing however, where it is necessary, takes place in the approval of a new guide.

Now, as I have said later on in the report, but I think that I should bring it out here, I can say that in the light of the last year and the developing of peaceful uses and the information from the Geneva Conference, we are reviewing very thoroughly our present guide and looking toward what should be modifications of the present guide. I think that there will be modifications and we are getting to this in due course.

Senator PASTORE. Now that you have mentioned the Geneva Conference, would you say that your impression as a result of the Conference is that possibly you have been a little too cautious?

Mr. STRAUSS. Might I respond to that, Senator?

Mr. FIELDS. I was not present at the Geneva Conference, sir.

Mr. STRAUSS. I would think not, Senator. It seems to me as I review the Conference in the light of the 6 months that have elapsed that we got rather less in the way of openness than we demonstrated. I do not mean by that to say that I regret in the slightest what we produced there. But for one reason or another, the returns were not commensurate in terms of the number of papers or the material that we acquired. That may be due to the headstart that we had.

Senator PASTORE. It is a fact, though, is it not, that there was more activity in relation to declassification just prior to the Conference than there had been for any comparable period before that?

Mr. STRAUSS. It was not declassification for the Conference, Senator. A great many papers were prepared for the Conference which were thereupon reviewed and were found declassifiable, but they were not declassified in order to make material for the Conference. I do not know whether I have made myself clear.

Senator PASTORE. I think you have, and would it be your impression now, as a result of the Conference and what transpired there, that you had reasonably carried out a declassification program that was satisfactory for the development of peaceful uses of atomic energy?

Mr. STRAUSS. In my opinion; yes, sir.

Chairman ANDERSON. May I ask a question here? Now, the law relating to this says that the term "restricted data," and I am quoting from section "r" of section 11:

> The term "restricted data" means all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material: or (3) the use of special nuclear material in the production of energy—

and it goes on and says—

> shall not include data declassified or removed from the restricted data category.

When the Shipping port reactor is finished, the Atomic Energy Commission is to some degree a partner in that venture, and it will be operating in 1957. It will produce energy. Will you keep it classified?

Mr. FIELDS. A large portion of the information on that reactor is already in a declassifiable area of information.

Chairman ANDERSON. It is producing energy.

Mr. FIELDS. That is right, but, in accordance with our recent guide, a great deal of the information with respect to that is declassified.

Chairman ANDERSON. Under section 142, which says:

The Commission shall from time to time determine the data, within the definition of "restricted data," which can be published without undue risk to the common defense and security, and shall thereupon cause such data to be declassified and removed from the category of restricted data.

In other words, if you could not show in the operation of the Shippingport plant, even though it had restricted data, that that restricted data could not be revealed without undue risk to the common defense and security, you could not keep it classified; could you?

Mr. FIELDS. That is right. We would not keep it classified.

Chairman ANDERSON. Now, on thermonuclear, I asked about declassifying thermonuclear reactions, and the letter says:

The Commission is, as you know, presently conducting a number of studies as to the feasibility of achieving controlled thermonuclear reaction. Although solution of the problem involved can by no means be regarded as assured, it appears that any thermonuclear reaction will be a substantial neutron producer capable of producing substantial quantities of special nuclear material. Hence, it is our opinion that information relating to the thermonuclear reaction is data concerning the production of special nuclear material, and falls within the definition of "restricted data."

Now, if it did not have special military application, it would not make any difference; would it?

Mr. FIELDS. That is right.

Chairman ANDERSON. You would have to follow what you said about Shippingport.

Mr. FIELDS. That is right.

Chairman ANDERSON. And if one of your own Commission members, Dr. von Neumann, and people like Dr. Teller, said it did not have military significance, it had to go to one of these 100 responsible reviewers and he would overrule Dr. von Neumann and Dr. Teller and say it could not be classified. Is that not what happened?

Somebody must have decided that it could not be declassified, even though it had no military significance, and it must have been one of these 100 reviewers; was it not?

Mr. STRAUSS. I do not think his testimony said it had no military significance.

Chairman ANDERSON. He said it could have slight military significance.

Mr. STRAUSS. I have not his testimony before me, but I discussed the subject with Dr. von Neumann several days ago, and I think that he will agree with me that the production of special nuclear material in the hands of an unfriendly power is a matter affecting the common defense and security.

Chairman ANDERSON. That is not what he said.

Mr. STRAUSS. I do not know what he said.

Chairman ANDERSON. Let us get it this way: The fact that it develops nuclear material is not the answer; is it?

Mr. FIELDS. That is the answer, depending on the significance of it.

Chairman ANDERSON. Oh, no. The fact that it develops nuclear material is not the answer. It is whether or not that nuclear material has any military significance. Is that not the correct point? You believe in the law, do you not?

Mr. FIELDS. Yes, sir; the fact that it has military significance is the point.

Chairman ANDERSON. Therefore, thermonuclear reaction, if it has no military significance, could not be kept classified, could it?

Mr. FIELDS. If it had no military significance.

Chairman ANDERSON. Thank you.

Mr. STRAUSS. Senator, may I say before we leave it in this form, that if the declassification of the entire thermonuclear research were to add the missing part to the research carried on on this subject by an unfriendly power and that as a result they were able to manufacture special nuclear material in quantities, this would in my opinion impair the common defense and security of the United States. That is a sufficient justification within the law for maintaining the classification of the subject.

Chairman ANDERSON. By the same token, you could keep Shippingport declassified, and the General Electric reactor that they are going to build for Commonwealth Edison, and Consolidated Edison, and by that token you can say if it produced this, or produced that, and if these things happened, then it could stay classified.

Mr. STRAUSS. I do not think the subjects are comparable, for the simple reason that the neutrons produced in the event of a successful breakthrough in the controlled thermonuclear reaction are of a totally different order than those that are available in the power reactors being built at Shippingport and planned for other places. It is a quite different kind of reactor.

Chairman ANDERSON. Then do you think we need some additional change in the law to cover this section?

Mr. STRAUSS. No; I think the existing language covers that adequately.

Representative DURHAM. For instance, how would you handle an experimental reactor program in your colleges? That is where you get some neutrons. For instance, if a thermonuclear engineer or a nuclear engineer wrote a paper, would he be subject to sending that paper to you for declassification if he is getting his doctor's degree, for instance?

Mr. STRAUSS. I do not think there is anything in the law that requires anyone to submit any papers to us, Mr. Durham. It is done by people who are anxious not to impair national security and the Commission, as a service to such persons, provides a review.

Representative DURHAM. Suppose someone up at Shippingport who was working there was an engineer, and decided to write a paper. Would he be subject to sending that paper to you for review before publishing it, under the present system?

Mr. STRAUSS. If he was working for a contractor? I know nothing in the law that requires him to submit it to us.

Representative DURHAM. Suppose that he has knowledge of something that, of course, is of a military value, and he probably would if the reactor is producing neutrons, and fissionable material, which it would—what would happen in a case like that?

Mr. STRAUSS. Well, the law applies to all citizens, and to such a man as well. If he violates the law, knowledge of which he is presumed to have——

Representative DURHAM. Is he furnished with a guide? He would not violate the law because I can see where we might get into difficulties there. Is Shippingport furnished with a guide, Mr. Marshall, that you have adopted, as a guide for your security? Are the Shippingport contractors, when they finish the reactors, furnished with a guide as to how to handle the security matters?

Mr. MARSHALL. The Shippingport people do have classification guides available to them now, and they will have after the project is completed.

Representative DURHAM. Will all contractors of reactors have the same guide furnished them?

Mr. MARSHALL. All contractors, you mean, throughout the project, or just at Shippingport?

Representative DURHAM. You have 7 contractors here building reactors which are going to produce neutrons.

Mr. MARSHALL. Each area of reactor development, that is, each of the various kinds of reactors, the Shippingport being one kind, are supplied with local classification guides or prepare local classification guides which fit their own needs as they are developing their projects. They do not all have exactly the same guides. They all follow, however, the same policies that are laid down by the Commission in the declassification guide, which is the basic document that covers all of them.

Representative DURHAM. What I am trying to find out is information as to the procedure, and how you are going to handle all of these different types of reactors, experimental and everything else, because certainly even in an experimental reactor there is some information that will still be classified, is that not correct? That is, even at the colleges? That is true, is it not?

Mr. STRAUSS. The research reactors at the colleges, I think, would be operating in an unclassified area.

Representative DURHAM. You have not put them in that area yet, though, have you?

Mr. STRAUSS. I believe they are unclassified.

Mr. MARSHALL. Yes, sir. The reactors that are in the colleges are unclassified. These small research reactors that are at present at places like North Carolina are completely unclassified.

Representative DURHAM. Then, a student would not be subject to any violation of the law if he wrote a paper?

Mr. MARSHALL. Describing the reactor; no, sir.

Representative DURHAM. He would not be subject to the law.

Mr. MARSHALL. If he wrote a paper that spoke of the reactor and its design and operation, he would not be in violation, of course.

Representative DURHAM. I am not talking about that. I am getting into the internal part of the reactor, Doctor, as to the production of neutrons, and things like that, because you know these nuclear engineers can write in almost any manner they want to. I am wondering whether that student would be subject to the violation of the law if he wrote a paper that was determined by this board of 100 members that it was a violation of the law. You would make a determination, would you not?

Mr. MARSHALL. If he wrote something that violated one of the topics of our guide—that is the declassification guide which says that certain kinds of information should be classified.

Representative DURHAM. And you decided it was a military nature.

Mr. MARSHALL. And if he published it, and made it available to unauthorized persons as the law states, we would have to make a formal report through the Division of Security and I assume that they would pass it along to the Federal Bureau of Investigation, if he did this.

Representative DURHAM. I think that we ought to make ourselves very clear on this point because I can see where we could get into a lot of trouble with it.

Senator PASTORE. May I ask a question along the lines that Congressman Durham has interrogated you? Parts of the Shippingport plant are classified, am I correct?

Mr. STRAUSS. At the present time; yes, sir.

Senator PASTORE. And an individual is entitled to deal with that information only because he has a Q clearance.

Mr. STRAUSS. That is right.

Senator PASTORE. Which he receives by permission of the Atomic Energy Commission.

Mr. STRASS. That is right.

Senator PASTORE. Let us assume in the hypothetical case suggested by Congressman Durham, that because of this Q clearance he has information and then he writes a paper. Is he placed on his own responsibility as to a violation of the security regulations, or must he clear it? Is there any procedure for clearing it? In other words, are we operating under a system that deters exploration in research and thinking—in research to the detriment of this whole field, or do we have some kind of a liquid and flexible process by which information of this kind can be developed and disseminated?

Mr. STRAUSS. Information of this kind is developed and disseminated, Senator Pastore, via the arrangement made between the Commission and the contractor for whom this engineer is working. Perhaps Dr. Marshall could speak further to the point of what the procedure would be if Engineer John Doe, working for the Duquesne Light Co., and with a Q clearance, develops a matter of interest.

Chairman ANDERSON. Keep it to what Senator Pastore asked. He had a student going to the college.

Senator PASTORE. Oh, no; I had an individual working for the contractor.

Chairman ANDERSON. All right. I thought it was a college student.

Senator PASTORE. No. In other words, the point I am getting at here is whether or not we are creating a block against the development of ideas because we are placing an individual on his own responsibility of knowing whether or not he violates the law and does so at his own risk or whether or not we are developing a procedure by which we encourage such initiative to the advantage of this whole program.

Mr. STRAUSS. The best practical demonstration of that is the fact that at the Geneva Conference which you attended, a large part of it, and I was about to say the bulk, but certainly a large part of the papers that were presented were written by employees of contractors of the Commission.

Senator PASTORE. That is right. Now, were those papers all cleared?

Mr. STRAUSS. Those papers were all submitted to the Commission, and they were reviewed and they were reviewed by the responsible reviewers and in some cases by the senior responsible reviewers. They were seen in many cases by Dr. Libby, and Dr. Von Neumann, and in no case that I know of was any paper accepted that had not passed through that kind of procedure.

Dr. LIBBY. I think that is a correct statement.

Senator PASTORE. Now, to get down to cases, coming back to the question raised by Congressman Durham, therefore even at Shippingport, if a man who has a Q clearance develops a paper does he now have to reveal it at his own risk or can he clear it with the Commission so that this information may be disseminated?

Mr. STRAUSS. He can clear it with the Commission.

Senator PASTORE. You do have a process of clearance?

Mr. STRAUSS. We do have a process that extends not only to such employees, but to the public generally.

Senator PASTORE. I think that you left a different impression when Congressman Durham asked you that question. In other words, I think that you intimated at that time or left the impression that the law is the law and a man cannot be ignorant of the law and he takes his own chances. That is not the case at all.

Mr. STRAUSS. He takes his own chances if he publishes without submitting it. That is clear. I will argue with you to the extreme, and suppose a man, whether or not he was the employee of a contractor, decided that he would write a paper on how a weapon was made and revealed it? I am going to the absolute extreme. Then he violated security? If he did that on his own, the fact that he violated security would have to be considered by the proper authorities of the Government in consonance with the provisions of the statute.

Senator PASTORE. And the man has no excuse, for the simple reason that if he desired to disseminate that information because he thought it did not violate security, he still had the opportunity of clearing it?

Mr. STRAUSS. Yes, of inquiring.

Representative DURHAM. But if he follows the guide that you furnish the Shippingport people, as far as clearance is concerned, there is no violation?

Mr. STRAUSS. I believe that the contractor——

Representative DURHAM. What good is the guide then?

Mr. STRAUSS. I believe the contractor is responsible, under those circumstances for a paper submitted by an employee to the contractor.

Representative DURHAM. If he has followed the guide, you people have cleared him under the guide for that information, for the writing of such information, and he is not subject to the violation of any law?

Mr. STRAUSS. He has a defense in any event, and a good one, I should think. He may have violated the law but he has a good defense.

Senator PASTORE. If he follows the guide, how can be violate anything? I think we are being a little over cautious, and I think we ought to get ourselves down to simple fundamentals and reach a conclusion. If the man follows a guide, he does not violate anything.

Mr. STRAUSS. There might be a question as to whether or not the guide had been strictly adhered to.

Senator PASTORE. If the guide were strictly adhered to, he has not violated any law.

Mr. STRAUSS. Then, with all respect to the lawyers, not being one myself, I would say that he had not violated the law.

Senator PASTORE. I venture to say that I agree with you.

Chairman ANDERSON. Now, suppose it is a college student working on a reactor that has been sent down and completely declassified. He gets a brilliant idea on thermonuclear or even weapon design and prints his own paper, and he has received no classified information, and he prints anything he wants to. Is he subject to any penalties?

Mr. STRAUSS. I think he would be subject to the penalties provided by the law, just as any other citizen.

Chairman ANDERSON. What could they be? He has not violated anything that has been communicated to him. He has thought it up himself, and it is his own idea.

Mr. STRAUSS. The law does not limit the dissemination of information to matters that have been communicated to you, but to certain classes of information as classes of information, Senator.

Chairman ANDERSON. So, that if he had his own idea, it could be restricted?

Mr. STRAUSS. I believe so. I again defer to the lawyers, but that is the way I have always understood the law.

Chairman ANDERSON. I understand now why the Federation of American Scientists hope that the declassification of thermonuclear, which had been extended to industry, might be extended to them, in the resolution which was passed this last week.

Senator PASTORE. To clear up the point that Senator Anderson brought up, and I do not want to belabor this too much, in other words, there is a restriction even on an individual who gets a brand new idea of his own. If that idea comes within the realm of security of this Nation he is dutybound not to reveal it but to give it to the Government. Now, am I clear, or unclear on that?

Mr. STRAUSS. I would like to refer that question to counsel, Senator.

Senator PASTORE. We keep talking so much about these precious ideas of scientists and individuals, as against what should be told and what should not be told, and what is possessive of a personal nature and what comes within the realm of national security?

Mr. STRAUSS. I believe the law is quite clear on this.

Senator PASTORE. Let us clear that point up. What is the answer?

Chairman ANDERSON. Let Mr. Mitchell give us the law that covers that.

Mr. MITCHELL. The answer is that if the information falls within the definition of restricted data under the statute, the individual receiving it would be responsible for treating it as restricted data, regardless of the fact——

Chairman ANDERSON. Now just a moment.

Mr. MITCHELL. He is under an obligation, Senator, to treat it as classified information, even though it may have originated with him.

Senator PASTORE. Let me put it this way. Supposing some individual, or some scientists, gets some brilliant idea on a super-duper thermonuclear weapon, and no one has ever heard of it before. Is that individual at liberty to write as he pleases about it because it is his own idea, or what are the restrictions upon him, or how does he handle that kind of information? I am not saying that it is possible, but in order to clear the law on the subject, let me give you that hypothetical case, and what is the answer?

Mr. MITCHELL. He would be authorized, Senator, only to transmit this information to someone who in turn was authorized to receive it—that is to say, somebody else who had proper clearance.

Senator PASTORE. There is a restriction upon that individual to impart that information only to persons who under the law are authorized to deal with it?

Mr. MITCHELL. That is right.

Senator PASTORE. That is simple.

Mr. STRAUSS. There are a number of parallel provisions, and you provide if a man finds a uranium mine in his backyard, he cannot go out and sell it to the Russians or Country X, or Y. He has a certain obligation to this country.

Senator PASTORE. I am not being critical, I agree with it.

Mr. STRAUSS. There is a parallel between uranium and thoughts.

Senator PASTORE. There is a price for being an American even if you are a scientist.

Mr. MITCHELL. You asked the section, and the two sections that are particularly pertinent are section 224 and section 227 having to do with communication of restricted data, and disclosure of restricted data.

Mr. NORRIS. Is not section 224 related to the criminal sanctions which are imposed on a person who communicates restricted data with intent to injure the United States or with the intent to secure an advantage to any foreign nation?

Mr. MITCHELL. There are certain elements of intent, it is true, in section 224.

Mr. NORRIS. And section 227 is:

> Whoever, being or having been an employee or member of the Commission, a member of the Armed Forces, an employee of any agency of the United States, or being or having been a contractor of the Commission or of an agency of the United States, or being or having been an employee of a contractor of the Commission or of an agency of the United States, or being or having been a licensee of the Commission, or being or having been an employee of a licensee of the Commission, knowingly communicates—

then he violates the section.

Chairman ANDERSON. I think if you could take the illustration we gave of the student, you would have an awful hard time fitting him into 227.

Mr. NORRIS. You would have a hard time fitting him into either one, I think.

Chairman ANDERSON. Of course.

Senator PASTORE. Are we not arguing here at cross purposes? Let us read this whole section. The section 224:

> COMMUNICATION OF RESTRICTED DATA.—Whoever, lawfully or unlawfully, having possession of, access to, control over, or being entrusted with any document, writing, sketch, photograph, and so on—

does that include the individual who on his own gets a brilliant idea and puts it on paper and disseminates that? Does he come within this section or is there some other provision of the law that takes care of it?

Mr. MITCHELL. I think he does come within this section, and he certainly would have possession.

Mr. STRAUSS. And he has control.

Mr. MITCHELL. He has control.

Senator PASTORE. Does not that presuppose that it comes through transmittal to him. We are talking about an idea now, and is that the thing that you are talking about? Is that lawful possession?

Mr. MITCHELL. Yes, sir, I think so.

Chairman ANDERSON. That is exactly what we are trying to get to, where there is an absolute iron curtain around thought.

Mr. STRAUSS. Gentlemen, you wrote the law and we are trying to carry it out.

Chairman ANDERSON. We did not write that in the law any more than we did that provision where they tried to say persons going into another country could not even talk about it. You changed that at Geneva, thank Heaven!

Senator PASTORE. I realize that we wrote this law, and we are responsible for it, but if we have made a mistake that is the reason we are questioning you gentlemen so as to be assisted in amending the law if it needs amendment. Let us be generous to one another.

Would you say that our law is embracing enough to cover the case that I have just suggested and how would you handle it if such a case came to your attention under existing law, as we in our ignorance wrote it?

Mr. STRAUSS. Senator, you make it hard to answer, in view of your last clause. Let us say that this student who had discovered this super thermonuclear weapon had published it. Obviously, then, the question of prosecution would be certainly locking the stable door too late. But it seems to me that the purpose, or I had assumed that the purpose of the Congress in enacting this particular statute was a caveat, to have something on the books that would prevent the compromise of a piece of military information of such value to the Government as this hypothetical invention might be. Obviously, there is no purpose in a prosecution of a man who had no intent to injure the Government after the event had occurred.

Senator PASTORE. No, the intention is written in this law. Now, suppose a scientist develops a brilliant idea on his own, without intention to harm anyone or to jeopardize the security of this Nation. But suppose he writes a paper on it. He is actually spelling out a super duper bomb that nobody ever heard of before. Is that man under existing law a subject of prosecution? That is a simple question. It is "Yes" or "No".

Mr. STRAUSS. I believe the Counsel stated that in his opinion the law would apply.

Chairman ANDERSON. Then, the ultimate answer is that everyone who has a thought must submit that thought first to the Atomic Energy Commission and ask if they are allowed to think it?

Mr. STRAUSS. No; I think not.

Chairman ANDERSON. They cannot print it unless they absolutely know that the Atomic Energy Commission is not going to restrict it as classified data, and say it is unlawful to think that?

Mr. STRAUSS. The law does not operate that way, and there is a great deal of material——

Chairman ANDERSON. That is precisely what we are trying to say.

Mr. STRAUSS. There is a good deal of material printed, and will continue to be printed, that everyone, including the author, and the reading public, and the Commission knows that it does not fall within any such category at all.

Senator PASTORE. Would Mr. Mitchell like to answer my question?

Mr. MITCHELL. Certainly, Senator, as I understand your question, this publication is innocent of any intent within the meaning of the statute.

Senator PASTORE. That is right.

Mr. MITCHELL. I think probably under those circumstances that prosecution under section 224 would not be possible.

Senator PASTORE. Do you know of any other section in the law whereby it might be possible?

Mr. MITCHELL. Assuming now that the individual in question is not within the enumeration of section 227.

Senator PASTORE. Not the originator himself.

Mr. NORRIS. I do not think it makes any difference whether it is originated with him or whether he receives it. It depends upon what his status is, and in section 227 there are a number of kinds of individuals listed.

Chairman ANDERSON. This fellow was a college student or a professor. He was not an employee of the Atomic Energy Commission.

Mr. MITCHELL. Then, Senator, I would say that he would run the risk of it being determined as to what his intent was when he did publish. If he had the kinds of intent that are enumerated in section 224, then he would be subject to prosecution.

Senator PASTORE. You assume something I have left out. I have already said in my hypothetical question that he intends to injure no one. We are getting into freedom of thought here now. He just got this brilliant idea and wrote it down on paper and lectured about it in the presence of his students in the classroom, and without even knowing that he was doing it he was giving the answer to a super-duper thermonuclear bomb. Is that fellow subject to prosecution under the law?

Mr. MITCHELL. No, sir; I would say he is not.

Chairman ANDERSON. Check your earlier answer.

Mr. MITCHELL. Seantor, the one point I would like to add is that what we have been talking about here is not thought processes, but communications, and the thing we have been addressing ourselves to is not whether a man can think or originate ideas, but the restrictions on his communicating those ideas to others.

Senator PASTORE. Even to a classroom without intending to do any harm?

Mr. MITCHELL. There, as I say, Senator, we get into the question of intent, but there is communication involved.

Chairman ANDERSON. Suppose Dr. Einstein thought up something and he communicated it to other people. If he were alive today would he be in jeopardy under this section then?

Mr. MITCHELL. It would depend entirely upon what was involved.

Chairman ANDERSON. Dr. Oppenheimer stated just a few days ago that he was looking for some great scientific break-through. He did not specify what it was at all. Supposing the idea did come, some scientific thing, through one of his students. He would have to worry about this section, then?

Mr. MITCHELL. If it were Atomic Energy Commission information and restricted data, I think he would; yes.

Senator PASTORE. I think we are all getting a little farfetched, but it is a good thing to talk about.

Representative DURHAM. I think that we are getting into a field here where we can expect more and more to be written than thought of, because it is getting into a wider field of dissemination with reactors in

the colleges and reactors in the hands of civilians, and I think we can expect it, and we have to meet it face on.

Mr. STRAUSS. We are hoping that it will happen. We are trying to stimulate it in every way we can.

Senator PASTORE. I think it would be a sad day if we ever created the impression that we were trying to muzzle brains.

Mr. STRAUSS. I think it has been indicated that there has been no prosecution instituted by the Commission on any such grounds, as far as I know, since we started operating.

Chairman ANDERSON. General Fields, we will start again.

Mr. FIELDS. I was dealing with recent progress in downgrading and declassification of industrial information.

The advantages of declassifying information become greater as the potential uses of atomic energy for peaceful purposes increase. In addition to the general statement of purposes in the 1954 act that unclassified scientific and technical information should be disseminated so as to encourage scientific and industrial progress, the Commission is directed to declassify information when it is determined that such information can be published without undue risk to the common defense and security. In the light of the foregoing considerations, the Commission, early in 1955, adopted a revised declassification guide which made possible the declassification of a large amount of information. The provisions of this guide also made it possible to downgrade to confidential another large body of information which could then more readily be made available to industry.

There is, of course, much more to the downgrading and declassification of information than just the making of the rules and the fixing of policy. It is also necessary to perform on a continuous basis the review of documents, so that information eligible for downgrading or declassification under the new rules can actually be downgraded or declassified.

The unclassified information that has already been made available through the use of the new declassification guide has enabled us to prepare textbooks and information source books for reactor training schools such as the one that opened at the Argonne National Laboratory last year.

For the industrial community of the United States, however, the most far-reaching advantage brought by the application of the new rules for declassification, will come from the program now in progress at Oak Ridge for reviewing all the secret and confidential papers from past years which may be of use to industry. Review of these papers started as soon as the new guide was adopted. In November, the Commission directed that the review be accelerated. This was done by bringing a group of 35 experts in various fields of science and engineering to Oak Ridge and putting them to work full time applythe principles of the new guide to a group of papers which might be useful to industry. This expedited review is to be completed in the very near future. Through February 2, 1956, the reviewing team had examined 25,029 reports. Of these, 8,965 had been declassified; 6,465 had been classified confidential; and 9,599 had been retained in a secret classification.

The declassification guide, as are all of the Commission's rules for the classification of information, has been under continuous review.

In accordance with this policy, set forth in the Atomic Energy Act of 1954, the declassification guide is now in the early stages of another revision. The entire field of atomic energy information is being reviewed in the light of current circumstances so that as much of it as possible, within the bounds of national security, can be made available to advance the peaceful uses of atomic energy.

I now come to the access permit program. Under the access permit program, which is discussed in section IV, procedures have been established whereby American industry may obtain classified information on the civilian uses of atomic energy. As of December 31, 1955, 686 applications for access permits had been received of which 602 had been approved. New applications are being received and processed at the rate of 60 to 70 per month. The holders of access permits represent a wide variety of industries as well as a wide range of potential fields of interest in the atomic energy industry.

Holders of access permits have been taking fairly extensive advantage of the information available under the program, considering the brief period that has elapsed since the program was established. Of the 602 permittees on December 31, 1955, 396 had cleared one or more persons to receive Restrictive Data and 205 had completed all security requirements, including clearance of facilities for the safekeeping of classified reports as well as of personnel to have access to classified reports.

Permittees are clearing substantial numbers of their people for access under the program. From July 1 to December 31, 1955, 2,612 "L" and 1,608 "Q" clearances were granted. Over 1,700 of the "L" and 400 of the "Q" clearances were new, the others being extensions and reaffirmations of previously existing clearances for use in connection with Access Permits.

Representative DURHAM. That is, civilian employees of the companies who are operating these reactors or will operate them; is that correct?

Mr. FIELDS. And some other firms who are interested in providing services or materials, as well as for the reactor project also.

The following table I reflects the types of industries and organizations represented by holders of access permits. Table II shows the distribution of permit holders according to the fields of interest indicated in their applications. Table III gives a breakdown of permit holders by size of organization, in terms of numbers of employees.

TABLE I.—*Business or occupation of access permit holders*

Metal mining and refining	21
Metal products manufacturing	107
Chemical manufacturing	56
Instrument manufacturing	42
Engineering and construction	57
Utilities	132
Research organizations	30
Consultants	56
Financial organization	42
Information and education	21
All others not elsewhere classified	38
Total	602

TABLE II.—*Access permit holders by field of interest (many permittees indicate more than one interest)*

	Number of permittees
Operating atomic facilities:	
Reactors for production of electric power	133
Reactors for other purposes	28
Plants to refine ore and process feed material	39
Chemical plant for reprocessing spent fuel elements	21
Manufacture of atomic energy products:	
Entire reactors	40
Components for nuclear facilities	123
Special materials for atomic energy application	49
Related activities:	
Waste disposal operations	8
Utilizing radioactive isotopes for sterilization of food, radiochemistry, research, etc	38
Design and construction of atomic energy facilities	56
General nuclear research	28
Consulting on atomic energy problems	54
Investing and lending capital	16
Regulation of utilities	1
Evaluating insurance risks	27
Education and training	10
Publishing and advertising	9
Others not elsewhere classifiable	36

TABLE III.—*Access permit holders by number of employees*

	Number of permittees
Number of employees:	
0 to 10	87
11 to 100	81
101 to 500	95
501 to 2,000	135
2,001 to 10,000	125
10,001 to 50,000	59
Over 50,000	12
Not given	8
Total	602

Chairman ANDERSON. May I ask if table I is identical with table I of the semiannual report on page 91?

Mr. FIELDS. I would have to check that, sir, and supply it for the record. I imagine it is quite close to it. This may be a little bit later.

(The information referred to follows:)

COMPARISON OF TABULAR MATERIAL IN SEMIANNUAL REPORT TO CONGRESS AND TESTIMONY BEFORE THE JCAE

Table I shown on page 121 of the transcript (printed hearings, p. 73 of the February 7 AEC testimony is the same as the first table on page 92 of the 19th semiannual report of the AEC to the Congress with two exceptions.

The table shown in the transcript combines the categories "Banks and investing companies" and "Insurance organizations" in one category designated as "Financial organizations." In addition, the table in the transcript uses the category "Information and education" in place of the category "Educational institutions" which is shown in the table of the semiannual report. Both tables were compiled as of December 31, 1955, and a total number of access permit holders is shown as 602 in both tables.

Mr. FIELDS. Unclassified and declassified information is, of course, available to all. In addition, properly cleared individuals who are either holders of access permits or employees of holders of access permits may obtain access to all classified information developed in the Atomic Energy Commission program except that which would

disclose weapons technology, gaseous diffusion technology, military reactor technology, and certain other information which is sensitive because of its relation to the weapons program.

Restricted data available under this program are listed in 27 subject categories which correspond to those used by the Commission in its internal classified document distribution program. All confidential information in these categories is made available to L cleared individuals employed by all holders of access permits. Secret information in any 1 of the 27 categories is made available to Q cleared employees of an access permit holder who has been granted access to that category.

Arrangements for documentary information for holders of access permits: As of December 31 more than 3,000 classified technical reports had been furnished to access permit holders, of whom 205 had completed all security requirements. The monthly volume of sales distribution of classified reports reached 700 during December.

As soon as an access permit is granted, and prior to security clearance, the permit holder is sent a package by the Atomic Energy Commission Technical Information Service. Included are a brochure, What's Available in the Unclassified Atomic Energy Literature and Where You Find It, and lists of the material available by purchase or in journals—some 16,000 nonclassified technical reports (including 1,200 Geneva Conference papers), special bibliographies and summarytype handbooks.

Representative DURHAM. You do not mean all 16,000 reports?

Mr. FIELDS. No, sir; this is just a list. This list notes the 9,000 Atomic Energy Commission nonclassified reports which are available for reference examination at the depository libraries. This gives the permit holder an early opportunity to evaluate the significant technical data available in the nonclassified literature. After the permit holder's facilities and personnel are cleared to receive classified information, he is sent a second package containing a brochure entitled "What's Available in the AEC Classified Literature, and Where You Find It," together with a set of the monthly classified abstract journal, Confidential Reports for Civilian Application. Copies of the confiidential AEC Declassification Guide, Schedule of Base Charges and Prices for Materials, and order forms and directions for ordering are also included. For permit holders granted access to to data classified secret, the package includes all these plus issues of a second monthly abstract journal, Secret Reports for Civilian Application.

Sale of classified reports. The Commission has established a classified document sales agency in the Technical Information Extension at Oak Ridge. Distribution of all classified documents to persons holding access permits is made by or through this facility. Price lists and order forms are furnished from Oak Ridge to all permittees.

Other activities in the industrial information program. The Commission's industrial information program makes available unclassified material to all who are interested in it and classified material to those who are eligible to receive it under access permits.

Some information activities, in addition to those described earlier, are designed to supply both unclassified and classified material to industry. These include a current project to identify and publish additional useful information now in the hands of contractors; a

writing and reference program to make information more useful; a program for providing engineering drawings; a service of technological consultation; and provision for seminars, meetings, et cetera, for industrialists.

Publishing additional industrial information. The Commission has directed that all informal reports, memorandums, et cetera, of possible industrial usefulness, now in the files of contractors, and not heretofore made available, be identified and considered by the Atomic Energy Commission for appropriate dissemination. Many of these informal reports and research memorandums, because of their incomplete or fragmentary nature, have not been circulated in the past. Under the current program, these informal materials are being reviewed to sift out information of industrial usefulness. In some cases, extensive rewriting will be required to pull together the bits and pieces of useful information scattered through documents originally prepared as internal working papers. The informal documents found to contain useful information will be listed and abstracted by subjects and made available on sale in the same manner as the more formal reports.

Writing and reference program to make information more useful to industry. The Commission has undertaken the preparation and publication of several types of special guides and reference aids designed to assist the individual in his search for particular information useful in his work. They are intended to guide him in choosing what he needs from the large volume of reports available and to present him with organized bodies of information. These guides include: (1) Monthly abstract journals describing and indexing the unclassified, confidential, and secret reports available under the access permit program; (2) selected bibliographies covering the most useful reports in particular fields; (3) proceedings of technical briefing meetings and seminars; (4) The Industrial Atom, a new series of unclassified monographs summarizing the state of research in particular fields; (5) Nuclear Science and Technology, a bimonthly review journal, classified confidential, pulling together material otherwise scattered through the AEC report literature; (6) handbooks and other summary-type compilations, prepared in both classified and unclassified editions, which collect and collate the best information available in broad subject areas important to civilian use.

At present six such books are being written: Atomic Energy Fact Book, Handbook for Reactor Control and Safety, Handbook on Waste Disposal, Radiation Shielding Design Manual, Nuclear Radiations in Industry and Science, and Corrosion and Wear Handbook for Water-Cooled Reactors. Five other books will shortly get underway: Production of Uranium Metal, Production of Thorium Metal, Fuel Fabrication Techniques, Recovery in Processing of Uranium Ores, and Recovery in Processing of Thorium Ores.

Engineering drawings. As an additional information service for industry, the Commission sells engineering drawings, such as those for the Oak Ridge research reactor and the materials testing reactor at the National Reactor Testing Station. More than 3,000 such drawings are now available to industry and the number is increasing rapidly. It is expected that demand for engineering drawings of instruments, equipment, and facilities will rise in coming months. To meet

this demand the Commission plans to establish a central source within its Technical Information Service for handling the selection, reproduction, sale and distribution of classified and unclassified drawings to industry.

Technical information. Individuals and firms are encouraged to utilize staff services provided by the industrial information branch of the technical information service. Here they may receive oral or written assistance as to information sources and may also be advised where particular work is being done, who is doing the work, and how they can learn more about it.

Seminars, meetings, et cetera, for industry. Another effective way by which the Atomic Energy Commission provides information to industry is through meetings, symposiums, seminars, and the like. In sessions of this sort, interested companies and organizations are enabled to have their technical staffs participate in organized discussions with the Atomic Energy Commission and contractor specialists for the purpose of acquiring current information on reactor technology, chemical processing of spent fuel elements, and on other areas of potential interest to industry. These meetings also serve to reduce the necessity for individual consultations.

The meetings open to the general public are publicly announced. Classified meetings are, of course, open only to cleared people and are brought to the notice of holders of access permits, particularly those who have expressed interest in the particular subject scheduled for discussion.

The following is a list of such meetings held or planned thus far:

Subject	Date	Place	Approximate attendance from private industry
Sodium graphite reactor technology	February 1955	Los Angeles	150
PWR briefing	May 1955	Pittsburgh	300
Chemical fuel element processing	July 1955	Oak Ridge	270
Sheet manufacturing of BORAL	October 1955	do	40
Borax, BER, EBR I, EBR II	November 1955	Idaho	115
LMFR and LM fuel elements	do	Brookhaven	200
PWR briefing	December 1955	Pittsburgh	275
Industrial supply of feed material	do	Washington	120
Industrial supply of feed material	January 1956	Cincinnati	85
Chemical fuel element processing	do	Idaho	120
HRE No. 2	March 1956 [1]	Oak Ridge	
SRE	June 1956 [1]	Los Angeles	

[1] Planned meetings.

Meetings of this kind have had an enthusiastic reception as evidenced by the attendance figures and are proving to be an effective method for making technological information available to industry. To broaden the usefulness of such meetings, the proceedings are published and made available as rapidly as possible.

In addition to the program of document dissemination and organized meetings, seminars, symposia, et cetera, which have already been discussed, individual visits of experienced technical men to the Atomic Energy Commission laboratories and production plants are another means of obtaining accurate up-to-date information. The Commission practice is to facilitate such visits when they do not unduly interfere with essential activities or plant operations.

We turn now to the steps the Commission has taken to encourage private industry to construct and operate facilities important in atomic energy development.

Chairman ANDERSON. Before you do, General, there was some discussion here a while ago about this hypothetical discovery of some gigantic superduper bomb, and I did not want anybody to believe that any such thing had actually been developed or that anybody had knowledge of it and was trying to hold it back. Please, will the members of the working press and others recognize that this was an extremely hypothetical question. It did not intend to reveal on the part of anyone some knowledge that somebody might have that something of that nature had ever happened.

In the first place, I want to say out of my own personal experience, when a man came to me and said he had developed a device that would be extremely important in the guided missile field, I communicated with the Atomic Energy Commission and the Atomic Energy Commission at once got in touch with him and tried to find out what he had in order to protect the interests of the United States, if any existed.

I think that the Atomic Energy Commission would be the very first to get into the field if they heard of any such information and properly safeguard it so that it would not be lost to this country or improperly used. I did not want anybody to believe that the conversation we had was based on the fact that somebody in the back of his mind had knowledge of a fellow who had an idea. This was a completely hypothetical question and by no stretch of the imagination did anybody have any particular person, idea, or possibility of an idea in mind.

Proceed, General.

Mr. FIELDS. The first step that I would discuss is the step the Commission is taking in the power demonstration reactor program announced a year ago. In launching this program the Commission believed that achevement of economic nuclear power would be brought nearer by construction of full-scale plants by industry. It was the Atomic Energy Commission's judgment that the first such plants would not be economic and that Commission assistance would be necessary to encourage industry. However, the Commission believed that the offer of assistance would not deter undertakings by industry to build full-scale powerplants entirely with its own funds.

The Commission's belief in this respect has been borne out. Commonwealth Edison Co., submitted 1 of 4 proposals under the program, but since it requested no financial assistance, it was treated as a straight license application. An application for a license to construct a large-scale powerplant without Government financial assistance was also received from Consolidated Edison Co. Pennsylvania Power & Light Co. has indicated its intention to proceed in the same way.

In the original announcement of the power demonstration reactor program, the Commission stated that it would consider requests for the waiver of charges for the loan of source and special nuclear material for fuel for a period until July 1 ,1962, and also for the performance without charge of specified research and development in its own facilities. This invitation was limited to proposals received by April 1, 1955. However, as a result of discussions with the joint committee and further study of section 169 of the act, the Commission clarified the basis on which it would give other assistance. In exchange for

desired technical and economic information rising from the project, the Commission will support research and development in privately owned facilities, provided the following criteria are met:

(*a*) The results anticipated have not been achieved before and, in terms of practical application, are speculative.

(*b*) The research and development work will provide data concerning the demonstration of the practical value of a power reactor.

(*c*) The Atomic Energy Commission itself would probably have to incur expenditure to secure information comparable to that to be developed.

(*d*) The amount requested is considered reasonable compensation for the information to be developed.

In order to place technical and economic responsibility on those constructing the plants, Atomic Energy Commission will require that its obligation to furnish assistance be subject to a fixed dollar ceiling. The proposer would take the risk of overruns, and would have maximum incentive to reduce costs, while the Government's obligations would be limited.

Two of the remaining three proposals received—those from Power Reactor Development Co. Inc. (Detroit Edison Co. and others) and Consumers Public Power District of Nebraska—have been accepted in principle by the Commission as offering a suitable basis for negotiation.

The proposal of the Power Reactor Development Co. Inc., requests a waiver of fuel use charge and the performance without charge of certain research and development in Commission facilities.

The initial proposal of the Consumers Public Power District of Nebraska was determined to be unacceptable. In its revised proposal, Consumers requested assistance with the cost of reactor construction in addition to the other forms of assistance offered in the program. Consumers stated that as a publicly owned utility it lacked the financial resources to pay for the entire cost of construction of an uneconomic facility.

The initial proposal of Yankee Atomic Electric Co. was also determined to be unacceptable. A revised proposal has been submitted and is under consideration.

Representative PRICE. Mr. Chairman?

Chairman ANDERSON. Mr. Price.

Representative PRICE. I have an inquiry on this Yankee Atomic Electric Co. proposal. That thing has been under consideration for 5 months. I wonder if you would give us some idea of what the holdup is on that particular application?

Mr. STRAUSS. I think while the negotiations are pending, Mr. Price, that might be inappropriate in an open session. We will do whatever you say.

Chairman ANDERSON. I was going to suggest, Mr. Chairman, I would feel better if you would review that with Mr. Price privately.

Mr. STRAUSS. We would be glad to tell you everything, but we are in the midst of a very active negotiation.

Representative PRICE. That will be all right.

Chairman ANDERSON. It seems to me that in a business transaction in which millions of dollars are involved you might jeopardize your trading position.

If there is no objection I would ask that you acquaint Mr. Price with it and at a later date we might ask you to familiarize the committee with the whole transaction.

Mr. STRAUSS. At his pleasure we will be glad to do it.

Chairman ANDERSON. I know, Mr. Chairman, that you do have an appointment that will necessitate your leaving.

Mr. STRAUSS. I appreciate that. Mr. Libby will carry on.

Mr. FIELDS. Shall I proceed, sir?

Chairman ANDERSON. Yes.

Mr. FIELDS. The proposals received under the program were all for large-scale reactors, 75,000 kilowatts electrical output or more. Because of repeated expressions of interest from rural and high-cost power areas and because of the importance of small-scale reactors to the international atoms for peace program, the Commission, on September 21, 1955, invited proposals limited to reactors in the range of 5,000 to 40,000 kilowatts electrical output. It also indicated that it would give preference to reactor designs calling for fuels using uranium containing no more than 10 percent uranium 235. This invitation, in addition to research and development assistance and waiver of fuel use charges, offered to consider requests for assistance in financing all or part of the reactor system provided the Government retained title to that portion financed. This offer was made in recognition of the fact that smaller scale plants were less likely to prove economically competitive and with the expectation that these plants would be most attractive to smaller groups less able to venture all of the risk capital required. Proposals under this invitation were received up to February 1, 1956, and, as we discussed this morning, Mr. Chairman, we received seven proposals. I would not propose to review that again.

Chairman ANDERSON. However, you are trying your very best to get these reactors constructed, sometimes by such a transaction as Consolidated Edison and Commonwealth Edison, where no subsidy is involved and where you may proceed by licenses, in other instances where you proceed on a partnership basis of some nature, and, finally, by almost direct subsidization of very small reactors which may be extremely useful in other parts of the world and possibly at home?

Mr. FIELDS. That is correct, sir.

I now turn to a section that deals with private enterprise and atomic services and supplies.

In furtherance of the policy of obtaining widespread participation in atomic energy, the Commission has encouraged private enterprise to furnish services and supplies, not only to meet new needs of Atomic Energy Commission, but also to meet the needs of the emerging atomic energy industry. To stimulate the growth of the nuclear power industry, it is necessary for the Atomic Energy Commission to provide certain materials and services from its existing facilities but, at the same time, these must be provided under conditions which will not inhibit private industry from entering these fields as rapidly as possible. Furthermore, the Commission is trying to avoid construction of Government-owned facilities to meet future requirements of Atomic Energy Commission for supplies and services which also are important to private atomic energy industry, and to look to industry to supply these requirements whenever possible.

Chairman ANDERSON. Will you pause for just a second, General?

Dr. Libby, would you ask Admiral Strauss if he would mind getting in touch with Congressman Price as early as possible on this matter so that if Congressman Price is not satisfied and we feel it necessary we can reopen it while the hearings are still in progress?

Dr. LIBBY. Yes, sir; I will be very pleased to.

Chairman ANDERSON. Thank you.

Mr. FIELDS. In encouraging private industry to furnish supplies and services, the Atomic Energy Commission has so far found four distinct combinations of circumstances. These combinations and the ways in which they have affected specific cases are discussed below.

1. Projected Atomic Energy Commission requirements exceed its own capacities; industrial demand is growing; and the time factor involved in Atomic Energy Commission's need for additional capacity is not on an emergency basis.

Atomic Energy Commission's existing and planned facilities for preparation of feed materials consist of a number of plants of different types at six locations. Estimates of ore availability and Atomic Energy Commission's uranium feed requirements indicate a future need for additional capacity in some steps in preparation of feed materials. The principal steps involved in preparation of feed materials for use in Atomic Energy Commission's production plants are refining (ores and concentrates to uranium trioxide, UO_3) and conversion steps (UO_3 to uranium tetrafluoride, UF_4, or uranium hexafluoride, UF_6).

The same processing steps would be employed to obtain materials for nuclear fuel for private power reactors. Thus, if this material can be supplied at reasonable cost and in time to meet Atomic Energy Commission's necessary requirements, a dual purpose will be served. The Atomic Energy Commission will not be obliged to build additional Government-owned facilities and one of the important components of an atomic power industry will have been started.

On October 27, 1955, the Atomic Energy Commission announced its interest in receiving proposals from qualified firms to process annually over a 5-year period, up to the equivalent of 5,000 tons of U_3O_8 contained in uranium ores or concentrates to uranium trioxide, uranium tetrafluoride, or uranium hexafluoride. Proposals are to be submitted by October 1, 1956, with deliveries desired to commence by April 1959. The first of a series of meetings with industrial representatives—holding the necessary security clearances—was held on December 8, 1955, in Washington. Seventy-one firms were represented at this meeting. A second meeting of firms expressing interest in submitting proposals was held January 12–13, 1956, at the Feed Materials Processing Center, Fernald, Ohio.

Another similar opportunity for industrial participation is in the recovery of uranium contained in certain scrap materials (magnesium fluoride slag, containing a residue of 2 to 4 percent of uranium) generated by Atomic Energy Commission uranium processing plants. Atomic Energy Commission has no facilities for recovering the uranium from this slag. Not only is the uranium of value but the magnesium fluoride itself has potential value as, for example, a source of fluorine in the manufacture of hydrofluoric acid. Therefore, on January 17, 1956, Atomic Energy Commission announced that it proposed to sell to the highest bidder the magnesium fluoride slag (on

an uranium content basis) and would agree to repurchase the recovered uranium at a stated price per pound.

Formal proposals will be solicited around October 1, 1956, thus allowing approximately 9 months for industry to study the technology and develop means of accomplishing the recovery. Meetings with interested industrial representatives will be scheduled.

Lack of irradiation facilities is being seriously felt in both military and civilian programs. Early last year, in order to meet the more urgent needs, proposals were invited for the construction and operation with private funds of an engineering test reactor. The invitation specified that the Atomic Energy Commission would contract for use of a substantial part of the irradiation capacity of the reactor. Although two proposals were received, neither offered a satisfactory basis for a contract. Since the facility is urgently needed, the Atomic Energy Commission is proceeding with construction of an engineering test reactor as part of the materials testing reactor complex at the National Reactor Testing Station.

Private industry has under consideration, however, a number of test reactors of smaller scope than the engineering test reactor. Since the combined requirements of Government and industry are expected to exceed total space available in Government facilities, the proposed reactors should prove most useful to industry in meeting the need for irradiation space of the type expected to be provided.

Beryllium metal of high purity is used in reactors as a moderator and reflector. Up to this time the only facility producing metal of reactor grade has been the Government-owned plant at Luckey, Ohio, operated for Atomic Energy Commission by the Brush Beryllium Co. Total projected requirements for beryllium now appear to be of sufficient size to warrant soliciting private industry for proposals to furnish beryllium on a fixed-price basis. In December 1955 private industry was notified of the Atomic Energy Commission's intent to invite proposals by public notice and by letters to 160 possible suppliers. The formal request for proposals was issued in January 1956 to 27 companies indicating an interest in supplying this material. Proposals are being sought for the supply of up to 500,000 pounds over a 5-year period, with deliveries to commence prior to December 31, 1957.

Another material, zirconium, is used as a structural material in reactors and in the fabrication of fuel elements. It was supplied originally from pilot plant facilities of the Bureau of Mines at Albany, Oreg. Production at Albany was discontinued in the spring of 1955 following the production of acceptable metal by the Carborundum Metals Co., Inc., and delivery to the Atomic Energy Commission on a unit price basis. Estimates of future requirements indicate that expanded production will be required. An announcement of the Atomic Energy Commission's intent to procure up to 3,500,000 pounds over a 5-year period was issued in August 1955, and letters were sent to 344 possible suppliers. In November 1955 formal requests for proposals were sent to 51 companies indicating an interest in supplying Atomic Energy Commission needs.

Proposals were due on February 2, 1956, and 10 have been received and are under consideration.

2. Atomic Energy Commission requirements are relatively in balance with Atomic Energy Commission capacities; industrial demand

is growing and is sufficient for economical operation of minimum-sized facilities.

The demand for power reactor fuel elements will eventually reach a significant volume. As now visualized, these elements generally are expected to be different in their shape, chemical composition, and isotopic enrichment from fuel elements made by Atomic Energy Commission for production reactors. Power reactor fuel elements will, therefore, not be amenable to the fabrication processes and facilities utilized for fabrication of production reactor fuel elements.

Representative DURHAM. Your anticipation of beryllium and zirconium is based on the civilian requirements, is it not, to a large extent?

Mr. FIELDS. It is civilian and military requirements.

Representative DURHAM. Civilian and military?

Mr. FIELDS. The need for it; yes, sir.

There is ample evidence that industry is willing to invest in the facilities (which are fairly conventional in nature) required for production of power reactor fuel elements. Consequently, routine fabrication of such elements in Atomic Energy Commission's production facilities will not be necessary. During the past year the Atomic Energy Commission has contracted to procure fuel elements from industry on a competitive fixed price basis; the Babcock & Wilcox Co. is to supply fuel elements at a fixed unit price for 1 year for the materials testing reactor. Eleven other concerns submitted proposals.

No problem is therefore anticipated in getting industry to fabricate materials to shapes needed for power reactor fuel elements. However, the Commission has no knowledge of any definite intentions of industry to provide capacity to convert uranium hexafluoride (enriched in the Atomic Energy Commission gaseous diffusion plants) to the metal or alloy form from which fuel elements can be fabricated. In general, only the capacity needed to meet Atomic Energy Commission requirements is available in the Atomic Energy Commission facilities. The Commission, therefore, is encouraging industry to construct facilities for this purpose. Since the investment required in such facilities is not unusually large and the technology is relatively conventional, the Commission's actions need not go beyond a specific informational program designed to acquaint industry with the need for additional feed preparation facilities and to disseminate the relevant technological information. Such a program is being planned to commence during the first half of 1956.

Boral, another material, is a mixture of aluminum and boron carbide clad in aluminum. It is used in shielding in the atomic energy program. This alloy was developed at Oak Ridge, and the Atomic Energy Commission facility there has been the only producer. Requests from private users for fabricated boral sheets are increasing and last year the Commission notified private industry, through a public release and by letter sent to 35 companies, of its interest in the establishment of an industrial source of supply. At a meeting at Oak Ridge, on October 28, 1955, representatives of 28 companies were given information on the use, preparation and fabrication of boral and inspected the Atomic Energy Commission boral facilities. Since then a commercial source has accepted an order for boral and is soliciting other orders at prices comparable to Atomic Energy Commission costs.

Representative DURHAM. Is that company producing any boral at the present time?

Mr. FIELDS. It has accepted orders. I am not sure whether it has started production as yet.

3. The Atomic Energy Commission requirements are relatively in balance with Atomic Energy Commission capacities; industrial demand is growing but is insufficient for economical operation of a minimum sized facility; and Atomic Energy Commission facilities are incapable of handling industrial demand without capital modifications.

Processing of irradiated fuel elements constitutes an essential step in the reactor fuel cycle. Chemical processing plants recover the fissionable and fertile materials present in the irradiated fuel elements and separate the radioactive fission products in disposable or usable forms. At present this processing step is being performed only by certain Atomic Energy Commission plants. If the Atomic Energy Commission were to process new types of fuel elements developed for power reactors, capital modifications to the Atomic Energy Commission plants probably would be necessary.

On January 5, 1956, the Atomic Energy Commission announced the establishment of a program to encourage private industry to build and operate plants for the chemical processing of irradiated fuel elements from research and power reactors. The goal of this program is to have commercial processing plants in operation as it becomes necessary to process fuel elements from privately owned power reactors. The Commission also announced that it would establish a date, about 18 months from now, for the submission by industry of proposals to build such plants. The Commission will consider contracting for the processing of limited quantities of certain irradiated fuel materials from Commission reactors to assure an economic base load for such a plant while the industrial load builds up to proportions which can support such an operation.

An information program on chemical processing has been under way to provide interested companies with information on existing technology and development work in process. As part of this program, a well-attended orientation meeting on chemical processing was held at Oak Ridge during July, 1955. Another such meeting was held at the National Reactor Testing Station in January 1956. Further meetings will be held if necessary to industry to permit preparation of proposals for this "base load" program, and to encourage widespread industrial interest and participation in the chemical processing field.

4. The Atomic Energy Commission and industrial requirements relatively the same as in 3 (above) but Atomic Energy Commission facilities capable of meeting industrial demand without requiring major capital modifications.

The present demand of the nuclear-power industry for uranium 235 is insufficient to support private operation of a gaseous diffusion plant solely to serve those needs. The Atomic Energy Commission, therefore, is planning future operations on the basis of allocating some uranium 235 production for the next several years to meet the needs of both domestic and foreign nuclear-power development. However, if industry evidences an interest in construction of plants for the

enrichment of uranium, the Commission would, of course, assist and encourage it.

Representative DURHAM. Would that not call for construction, to meet future needs, of other gaseous-diffusion plants?

Mr. FIELDS. We do not see that it is required at this time, sir. It depends on the demand as it grows over the years ahead. This is merely to indicate that industry has not shown an interest in this at this time because of the capital involved in the construction of such a plant, and the demand is growing at this time.

Representative DURAM. There has been no interest by private enterprise in the gaseous-diffusion plant yet?

Mr. FIELDS. Not expressed to us, sir.

Chairman ANDERSON. It would involve an enormous private investment.

Mr. FIELDS. Yes, sir.

The next section is prices and charges, and then that will be the final part of this section.

In an earlier section of this report, we discussed some of the specific actions which the Commission has taken to encourage private industry to furnish services and supplies not only to meet new needs of the Atomic Energy Commission but also to meet the needs of the emerging atomic-energy industry. An important aspect of assisting in the establishment and growth of a private and independent atomic-energy industry is the pricing policy of the Commission.

This policy has been developed on an agencywide basis and applies to materials sold, research and development assistance, manufacturing, various other services furnished to, and the use of Atomic Energy Commission-owned facilities by others either directly or through Atomic Energy Commission contractors.

In establishing charges for materials and services provided to private users, the Commission followed the criteria for the sale and use of materials and services set forth in the Atomic Energy Act of 1954. These criteria give emphasis to nondiscrimination among users, reasonable compensation to the Government, encouraging research and development, and not discouraging the development of sources of supply independent of the Commission.

For those materials and services which it must supply because there is at this time either no other source of supply or an inadequate supply, the Commission has adopted a policy which states that full cost or the going commercial rate, whichever is higher, is to be recovered in establishing charges for such materials or services. In setting charges to recover full costs there are included all direct expenses, all indirect expenses including depreciation, and an added factor to cover Atomic Energy Commission overhead, interest on investment, process improvements, special handling not susceptible to costing, and other intangible expenses.

The Commission policy on sales is designed to encourage persons outside the Atomic Energy Commission to develop adequate sources for materials and services. To the greatest extent practicable, Atomic Energy Commission sales and services will be reduced or eliminated as adequate and reasonably priced outside sources become available.

The Commission established in January 1955 a classified schedule of charges for some of the various materials needed for the peaceful uses of atomic energy, including natural, depleted, and enriched

uranium, thorium, and heavy water. The Commission announced on an unclassified basis charges of $40 per kilogram for natural uranium and $25 a gram for uranium 235 contained in uranium at an enrichment of 20 percent in uranium 235. The latter figure applies to amounts of 6 kilograms of contained uranium 235 or less.

It is the expectation of the Commission that these charges will remain reasonably firm, but they are not guaranteed. The Commission recognizes that as the sole supplier it should proceed with caution in making changes in these charges which might upset the long-range plans of firms now starting a new industry. It does not intend to make a change unless technological or other factors substantially increase or decrease costs. To date there has been only one change. The charge for thorium metal was increased from $25 to $43 per kilogram.

The basic policies to be followed in furnishing these materials are:

1. The Atomic Energy Commission will make special nuclear material available to facility licensees for the period of the licenses.

2. The Atomic Energy Commission will lease or sell other reactor materials which are not available commercially.

3. The basic use charges for special nuclear materials, source materials, and other reactor materials, which are furnished by Atomic Energy Commission, will be computed at a fixed rate. At the present time this rate is 4 percent per year of the value established in the schedule of charges for the amount of material delivered to the licensee.

4. In addition to the use charge, licensees will be charged at rates indicated in the schedules for special nuclear materials consumed or lost.

5. No use charge, or other charge, will be made for the use of special nuclear materials produced by licensees until after the Commission has paid for such materials.

6. Charges for conversion of uranium hexafluoride to fuel material, fuel-element fabrication, scrap recovery, and processing of spent fuel elements will be estimated separately for each job on the basis of recovery of full costs.

At the same time it established a schedule of charges, the Commission also established a schedule of fair prices that will be paid for plutonium and uranium 233 produced in privately operated American reactors.

1. The prices to be paid by the Atomic Energy Commission for plutonium and uranium 233 are based on materials which meet Atomic Energy Commission specifications. If material is furnished in some other form, the cost to the Atomic Energy Commission for conversion to meet specifications will be deducted.

2. Prices to be paid by the Atomic Energy Commission for plutonium and uranium 233 produced by licensees are guaranteed for a period of 7 years from July 1, 1955, except for periodic adjustments if there are changes in excess of 5 percent in the Bureau of Labor Statistics Wholesale Price Index, Excluding Farm Products and Processed Foods.

The Commission has published a notice in the Federal Register announcing that it had established a schedule of fair prices for special nuclear materials and specifications for plutonium metal, uranium 233 as metal and as uranyl nitrate solution which producers must

meet to obtain those prices. The schedule of prices and the specifications are classified confidential and are available upon request to cleared persons.

That completes the section, sir.

Chairman ANDERSON. General, when was this material prepared and available; do you know?

Mr. FIELDS. Which materials?

Chairman ANDERSON. This section that you have just finished reading. When did you first see it?

Mr. FIELDS. I believe it was prepared just in the last week or so.

Chairman ANDERSON. How about Mr. Davis? When was his prepared?

Mr. FIELDS. These papers have been under preparation for a month or so. They came into final form, some of them, in the last week or perhaps earlier. I would have to check back on the specific parts of the report, sir.

Chairman ANDERSON. The reason that I ask is I understood while I was out that some remark was made by the Chairman—maybe you can enlighten me, Dr. Libby—that they had asked for guidance as to the type of report we wanted in October and again recently and had not had a reply. Do you know what the remark was?

Dr. LIBBY. That was my understanding of his remark, but I do not remember the dates.

Chairman ANDERSON. The first date was October. I will be very happy to review this when Admiral Strauss is here again, but as to this recent request, General, what was the recent request?

Mr. FIELDS. I believe the Chairman was probably referring to his letter of last week to you, sir.

Chairman ANDERSON. Yes; on Friday. If the paper had been prepared for 10 days ahead of that, what guidance was he seeking?

Mr. FIELDS. I cannot speak for the Chairman, sir.

Chairman ANDERSON. He indicated by Friday he asked me to indicate what we would like to have you testify upon, and your testimony was all prepared, was it not? That is just what you said, that you have been working on these for weeks.

Mr. FIELDS. We have been working on this for some time, yes.

Chairman ANDERSON. Mr. Kelehan sent over on the third day of February—it reached our office at 5 o'clock in the afternoon—an outline of the testimony. February 3 was Friday; was it not?

Mr. FIELDS. I believe so, yes.

Chairman ANDERSON. And the staff does not customarily work much on Saturday. I was engaged in a long agricultural session that began at 10 o'clock in the morning and ran until 11 o'clock at night.

Is he referring to the fact that we did not comment on this prior to Monday?

Mr. FIELDS. I do not know.

Chairman ANDERSON. Would you try to clear the point up when you return?

Mr. FIELDS. Yes, sir.

Chairman ANDERSON. I received a letter from Mr. Strauss on Monday asking what we would like to have him testify to on Tuesday and I replied to it on Monday telling him that we already had the testimony, and I am happy to have it confirmed that your section was ready 10 days ago.

You used one word that worries me a little.

Representative COLE. Before you reach that point, I think I am somewhat instrumental in this remark by Mr. Strauss.

Chairman ANDERSON. I wish it had been made while I had been present.

Representative COLE. He felt compelled to make the remark at the time I raised the question when I did, and unfortunately the chairman was not present. It was a question of whether you would continue to sit and listen to Mr. Davis present a detailed discussion of the various and specific types of reactors, and I suggested to Mr. Durham that perhaps we might pass up listening to the reading of the specifics of the thing. It was then that Mr. Strauss said that he was not certain just how the Joint Committee wanted the Commission's testimony to be presented and that they had built it up in this fashion. Mr. Strauss thought, I got the impression, that I was being critical of the way the Commission was presenting it, which, of course, I was not, so I was involved in whatever expression be made. I do not think that Mr. Strauss meant to be critical of the committee, but simply that the Commission had not had any specific guidance from the Joint Committee as to what extent and how detailed the presentation the committee wanted the Commission to give should be.

Chairman ANDERSON. Of course if we told you what to leave out, then we really would be criticized for censoring the Atomic Energy Commission or trying to circumscribe what the Atomic Energy Commission might say. That is my only difficulty in it.

I am just trying to calculate here about how many days it would take us to get through this if we did not ask a single question. This is approximately the same length as Gone With the Wind. I am only trying to say that we asked you to tell us about the development, growth, and state of power, and we have 3 days set aside for it; and you come in with something that you cannot possibly read in 3 days if we let you read it.

That is the only reason I was asking the question, and I think Congressman Cole has somewhat the same idea. We would like to develop these things by the question and answer method, but if we do we so greatly delay the presentation that it makes it very difficult. I did not want the impression to be left that you had been seeking guidance from us as to what to do and we refused to give it to you because, after all, it is not our function to tell you what to say about the development, growth, and state of power, or we would not invite you to come over and state what you think about it.

Dr. LIBBY. We would certainly like to present it in the way that you would find most convenient, and enlightening, and helpful.

Chairman ANDERSON. I remember in my earlier days when I occasionally read poetry, it seemed that I found Keats saying:

"Beauty is truth, truth beauty"—that is all ye know on earth, and all ye need to know.

He got it down to five words. I do not expect to get the testimony down to five words, but it would seem to me it might be well if we could have it in an hour and a half in the morning, and then a half hour or maybe longer for discussion, and then something else in the afternoon. I am only saying it, Dr. Libby, in the hope that as we continue to work these things out in subsequent years we may come

to a better way of presenting the things that are vital in the development and growth and state of the art.

As General Fields well knows, I have the highest opinion of him and the greatest personal affection for him, and this is not directed as a club at him by any means.

Representative COLE. Mr. Chairman?

Chairman ANDERSON. Congressman Cole.

Representative COLE. In connection with the pricing of materials, particularly special materials, to what extent do you find that the prices are a major factor in deterring people from going into business and building reactors?

Mr. FIELDS. Did you say "special materials"? You mean special nuclear materials or fuel materials?

Representative COLE. Fuel materials, special nuclear materials.

Mr. FIELDS. It would be difficult for me to say that the prices we have indicated would be charged for these materials would be deterring or encouraging because they are a very crucial factor in the economics of the reactor.

Representative COLE. Crucial in what way? From an economic standpoint?

Mr. FIELDS. One of the crucial factors from the standpoint of economics, yes, sir.

Representative COLE. And, of course, from the operation?

Mr. FIELDS. And from the operations also. I should not have said "crucial." They are one of the significant cost elements in the power reactor.

Representative COLE. That depends on what you mean by significant and that is what I am trying to find out. How significant is it?

Mr. FIELDS. Perhaps I should ask Mr. Davis to cover this point for you. It varies with the reactor designs, but as to the mills per kilowatt-hour that might be in the cost of the end product of power, that would be the cost attributable to the consumption of the fuel itself. This varies, but it may be several mills per kilowatt-hour in some cases. It may be larger in others.

Representative COLE. Then I will ask, Mr. Davis, have you had any applicants who have come in wanting a permit to build a particular type of reactor and have said to you, "Well, the price you put on this special material that I have to use in this reactor is just so high that I cannot see my way clear that I will come out whole on it or reasonably close to whole, so what am I going to do?" Have those situations ever arisen?

Mr. DAVIS. I know of no such occasion, Mr. Cole. There are many other cost factors in power reactors that are considerably higher than the cost of special nuclear material. I think as a general case I can say that the cost of special nuclear material in a reasonably good reactor is actually by itself alone less than the cost of the conventional fuels with which it is competing.

Representative COLE. That is a very interesting observation which I was not aware of, Doctor. You say now that the cost of the special fuel in an atomic reactor relating to the total cost of the reactor itself is proportionately no greater than the cost of the conventional fuel in a conventional boiler? Is that substantially it?

Mr. DAVIS. I was not relating it to the total cost, but merely to the cost of the nuclear fuel that you would consume in a reactor compared

with the conventional fuel that you would consume in a conventional boiler plant. By and large the nuclear fuel is less than the cost of the conventional fuel.

Representative COLE. Then I judge from that statement it is your belief that the price of the special fuel consumed is not a significant cost in the construction and operation of a reactor?

Mr. DAVIS. It is significant, but it is not large. I do not know quite how to make the distinction.

Representative PRICE. Will the gentleman yield?

Representative COLE. Yes.

Representative PRICE. Did not one company request a waiver on the cost of fuel, the Power Development Reactor Co.?

Mr. DAVIS. Under the power demonstration program we offered a waiver of the fuel use charge; in other words, the 4 percent per year on the inventory. We have not offered for power reactors a waiver for the charges of the material consumed. I am speaking now of the actual cost of the material which is consumed.

Representative PRICE. However, the same company does want to be paid for the plutonium produced?

Mr. DAVIS. Yes, sir.

Representative PRICE. It did?

Mr. DAVIS. Yes, sir.

Representative COLE. Do they not all want to be paid for the plutonium they produce?

Mr. DAVIS. Yes, sir.

Representative COLE. There was nothing about this particular company that Mr. Price speaks of that was unusual, was there?

Mr. DAVIS. Except to the extent that it is more important in their economics.

Representative PRICE. Of course, there was no waiver in connection with the other applicants that you have. That was unusual?

Mr. DAVIS. Yes. In a fast reactor one has a relatively large inventory, especially nuclear material, and the profit from the sale of plutonium is particularly important. You are making more of it than the U–235 that you burn up.

Representative COLE. Am I right in having the feeling that the price of the fuel that is in an atomic reactor is not a matter of great moment in retarding the progress of atomic development?

Mr. DAVIS. I quite agree with you, sir.

Chairman ANDERSON. It is not a significant retarding factor at least at the present time?

Mr. DAVIS. No, sir. There are many others that are considerably larger.

Chairman ANDERSON. Congressman Durham.

Representative DURHAM. I am a little bit disturbed on this matter of beryllium, thorium, boral, and those elements that are absolutely necessary in the planning and building of reactors. At the present time if we were to have a great influx of private industry making applications to build reactors, what kind of shape would we be in as to beryllium and boral and those metals that would be absolutely necessary in the building of reactors?

Mr. DAVIS. I think at the present time probably our greatest limitation would be on something such as zirconium.

Representative DURHAM. I intended to mention that one, too.

Mr. DAVIS. Zirconium is used in most of the water-cooled or water-moderated reactors and today we simply do not have industrially enough capacity for producing zirconium. This effort to start a larger scale industry is partially directed toward trying to have an industry which could supply such materials to private reactors.

Representative DURHAM. I think General Fields has great responsibility under this section that you just read because it is the heart of the whole problem, trying to do what you are doing right here in these pages that you have just read, and although you have these people interested and you are negotiating, you do not have any plant in production by private enterprise yet of either one of the metals, have you?

Mr. FIELDS We have the Carborundum Co. in production on zirconium at the present time.

Representative DURHAM. Although you have written in that you need 3,500,000 pounds.

Mr. FIELDS. That is over a period of the next 5 years.

Representative DURHAM. Yes, which is a pretty good inducement, I should think, to private enterprise to get into this business.

Mr. FIELDS. We hope that it is.

Representative PRICE. You also have boral under private contract?

Mr. FIELDS. That is correct. This all had to do with interesting industry in materials and supply services by such steps as these.

Representative DURHAM. Are you satisfied with the progress you are making there, General Fields?

Mr. FIELDS. I could tell you better later, in a few months. We have gone out and we are trying to interest industry and we think we can interest them in zirconium and beryllium.

Representative DURHAM. I like your approach to it because you are telling the people what your needs are going to be. In other words, you are commiting yourself.

Mr. FIELDS. Yes, sir.

Representative DURHAM. I think you are offering as much as you possibly can here if the price is all right. I do not know anything about the negotiations, whether you have to get down to a point where you cannot reach agreements on the price.

Dr. LIBBY. We have gotten 10 responses, have we not?

Representative DURHAM. I notice you have 10 on the zirconium.

Chairman ANDERSON. One at a time, please.

Dr. LIBBY. I just wanted to call attention to the fact that on the zirconium we had gotten 10 responses in by last Thursday.

Representative DURHAM. You say at the present time you are negotiating. Where are you having your negotiations? Are you making any progress in them?

Mr. FIELDS. Do you know the status?

Mr. DAVIS. On the zirconium we just received the proposals and they are presently in the process of being evaluated and we hope to enter into contracts sometime fairly soon. I cannot say how soon.

Chairman ANDERSON. If at any time you get into a question of negotiations where you think for the protection of yourself you should not comment on negotiations, Mr. Durham would be the first one to agree that that should not be done.

Representative DURHAM. That is right. The only thing I am concerned about is whether or not we are going to get the things we need,

and I am concerned about promising industry something here that we will not have in existence when the time arrives that they are ready to come in and want to get a license to build a reactor, and then you say, "Well, we do not have any zirconium," or any beryilium or any boral. I do not want to see us get into that kind of a predicament if we can help it.

Chairman ANDERSON. Do you think we are protecting ourselves adequately That is your question

Representative DURHAM. Yes.

Mr. FIELDS. We certainly think we are protecting ourselves adequately. We believe that we can proceed in this fashion to meet our requirements. If in getting through these proposals we think otherwise, we would take a different course. It does take constant surveillance of this to insure that we can meet our requirements in this fashion.

Representative DURHAM. How long would you think it would take to put into production a zirconium plant so it would be producing metal? How long do you think it would take a good concern, some reputable concern?

Mr. DAVIS. A year to 18 months.

Representative DURHAM. You have known about this for the last 6 months, have you not?

Mr. DAVIS. Yes, sir.

Representative PRICE. Have you had any outside work for zirconium?

Representative DURHAM. You are still in a negotiating stage, are you not?

Representative PRICE. Is there any market outside of this program for zirconium?

Mr. DAVIS. I do not know of any large market. There are very small uses, for medical purposes and things of that sort, but they are not large tonnagewise.

Dr. LIBBY. I do not believe there is any, sir, because it was developed for our uses.

Representative PRICE. You do not have a very easy problem going around selling private industry in investing in zirconium merely for the purposes of this program.

Dr. LIBBY. We hope the atomic power program will be sufficiently interesting.

Representative DURHAM. There is no shortage of raw material in the production of zirconium?

Dr. LIBBY. No, I don't think so.

Representative DURHAM. Is there any shortage in the production of beryllium, of the raw material, that is?

Dr. LIBBY. I am not so certain about that, sir.

Chairman ANDERSON. I should not speak, but does not Climax Molybdenum supposedly have a mine that could produce quite a bit of beryllium?

Dr. LIBBY. I am pretty cold on this. I will have to ask the general manager.

Chairman ANDERSON. I think we are colder than Jesse Johnson. If there is a sufficient supply of zirconium and you have known about the extreme need of it for 6 months, do you not think it is nearly time to get out of the negotiating stage and into the starting of a plant?

Dr. LIBBY. We are not going to let the plants run short of zirconium, I am sure. Is that not right?

Mr. FIELDS. That is right.

Representative DURHAM. May I ask you this: You know we have to have this material. Of course I am one of those who feels that if private industry does not do it I think we should do it.

Mr. FIELDS. That would be our intention, if we cannot out of these proposals come to satisfactory contracts.

Representative DURHAM. Have you put any time limitation on these proposals?

Mr. FIELDS. They were due on February 2. We have received 10.

Representative DURHAM. That is what I notice from your statement. You received 10.

Mr. FIELDS. Yes, sir.

Chairman ANDERSON. I think if they were only received on February 2 you have a right to look them over. We will wait another week or so before we get very hostile.

Representative DURHAM. However, they put out the notices that they needed this material last when?

Mr. FIELDS. In August, sir.

Representative DURHAM. That is what I thought.

Mr. FIELDS. We put out a formal request in November of 1955.

Representative COLE. I have another question. On the question of prices for materials, and so forth, and with respect to the price of isotopes, has it been your experience that there is any indication of complaint about the prices charged by the Commission for the various isotopes used in industry?

Mr. FIELDS. I do not know of any complaints from industry on this point, but perhaps I should check more thoroughly on that and give a reply for the record. As far as industrial uses, I am not aware of any myself.

Do you have any information?

Dr. LIBBY. I know of 1 or 2 instances where the prices have been, I would say, slightly hampering in the beginning, special uses that were just being developed.

Representative COLE. I am limiting it now entirely to industrial uses.

Dr. LIBBY. This was potential development, industrial development; yes, sir.

Representative COLE. Then, you have two cases, you say, where the price of the isotope may have been a deterring factor?

Dr. LIBBY. May have been involved in deciding whether the group would go into the business.

Representative COLE. What is your experience or your observation with respect to isotopes used in research generally?

Mr. FIELDS. May I ask, sir, that I have a member of my staff here to answer that? I cannot give you this information. Dr. Johnson, the Director of the Division of Research, may be able to answer your question, sir.

Dr. THOMAS H. JOHNSON (Director, Division of Research). I am not sure that I can give any information here that Dr. Libby does not know better than I, but in the field of physical research the price of isotopes is generally such a small part of the total cost of the research

that I have never heard of anyone complaining about the cost of the isotopes. I would doubt very seriously that for laboratory research and the physical sciences the cost of isotopes has very much of an effect on the decision to go ahead with the work.

Representative COLE. What other types of research are there besides physical?

Dr. JOHNSON. Of course, there is medical research. There is a subsidy for isotopes for medical research.

Representative COLE. What do you mean by "there is a subsidy"?

Dr. JOHNSON. The Commission pays part of the cost.

Mr. FIELDS. In the case of medical research, sir, biology, and agriculture we give a discount of 80 percent on the normal price charged for the radioisotopes. This has been specifically to foster their use, medical, biological, and agricultural.

Representative COLE. I think that is part of the law, is it not, that you should not charge more than 20 percent, or at least there is some expression in the law encouraging the Commission to charge as little as possible?

Mr. FIELDS. Yes, sir.

Representative COLE. I have one other question of Dr. Johnson. What other types of research? There was mention of medical, biology, and agriculture.

Dr. JOHNSON. There is engineering research.

Representative COLE. Certainly the price of isotopes there is not a cause of complaint.

Dr. JOHNSON. In engineering research, I know of one case where a company, a laboratory, would like to have, say, two megacuries of radio cobalt. That is about what we would produce in 5 years. Of course, I am not sure it is the price so much as it is the unavailability of it that is the deterrent in that case, but they will probably have to take some other route to get radiation levels of that magnitude.

Representative COLE. Do you know of any other cases?

Dr. JOHNSON. No, sir.

Representative COLE. Dr. Libby knows of two cases where the price of isotopes was a matter of significance in industrial uses. Dr. Johnson says there is one case that he knows of with respect to isotopes in engineering research.

What prompts my inquiry along this line is the recommendation of the McKinney panel which is—this is my recollection—to the effect that in order to encourage greater use of isotopes in research in all fields the Commission should reduce its charge to a nominal level or eliminate the charge entirely. That might be a sound conclusion because certainly we all want to encourage the use of isotopes as widely as possible in all phases of research, but if it is the record that the price of isotopes is not discouraging research in the various aspects, then it would seem that there is no reason why the Commission should reduce the price of isotopes.

Dr. LIBBY. We are certainly going to take very careful count of the panel's recommendations, all of them.

Representative COLE. Surely, you will; of course.

Chairman ANDERSON. General Fields, before you get through with this subject, you used a word that I regard as a very bad word. You used the word "declassifiable." Do you recall that? It was not in your prepared testimony. Could we not agree that if it can be de-

classified it must be declassified and therefore is not declassifiable? That is all.

When it gets to the point where the testimony is that it should not be classified any longer, why do we not declassify it and made it declassified and not declassifiable? That is all. You said it just casually and I do not think that you meant to deter it and I know you did not.

I am just saying that that is one word that I hope we get out of our vocabulary so that when something should be declassified we promptly declassify it and do not have it declassifiable.

Representative COLE. Is not all restricted data declassifiable?

Mr. FIELDS. If the Commission determines that it can be.

Representative COLE. It is all declassified, as I understood the word "declassifiable," to be as you used it.

Chairman ANDERSON. No. He used it in connection with material that was declassifiable, which he said was something that should be declassified, but they just had not gotten around to it yet. I agree with my able and distinguished colleague from New York that probably all of it is at some time declassifiable, but I am just hoping we keep on declassifying them.

Representative PRICE. I would like to ask 1 or 2 questions. Does the Commission have a feeling of satisfaction as to the number of proposals which it has received in the industrial participation in power reactors in research?

Mr. FIELDS. That would be my personal reaction, yes, sir.

Dr. LIBBY. Yes, I think we do. The number, I think, was very gratifying, yes.

Representative PRICE. Is there anything that you could think of that might be holding down that number? Is there anything that you can think of that will encourage more industrial participation or greater industrial participation?

Dr. LIBBY. I do not think there are any reasonable changes in our conditions within the act and our declared policy which would increase the number very significantly. I may be wrong. I think that we received a very gratifying response both in the first and the second round, but we are still studying the second round. We might have wanted more interest in certain types of reactors than was shown, but the number was good and I think we have to answer your question yes, that we received a very gratifying response and about as much as we could have expected.

Representative PRICE. That is all.

Mr. FIELDS. I think it was gratifying also that in ths case of Consolidated Edison they came in for a license request, and that likewise we know that Pennsylvania Power and Light Co. have indicated their intentions of proceeding along this line; and we want industry to know that the Commission is always open for applications for licenses, straight out reactor development projects of the nature and in the manner that these requests came, as well as our power demonstration program that we have instituted for providing some assistance where necessary.

Chairman ANDERSON. Mr. Norris.

Mr. NORRIS. In the light of all of the comments which are being made now about the problems of restricted data being born classified, I would like to ask Mr. Mitchell if it is not true that at one point

in the drafting of the Atomic Act of 1954 the staff, not the members, but the staff, of the joint committee tried drafting section 142 so that the material would be born not classified, and the Commission had the right to make it classified, and did not the Commission at that time come up and say, "This raises considerable constitutional objections" and the staff withdrew its position and went back to the original draft?

Mr. MITCHELL. I am sure if that is your recollection it is right. I do not have any specific recollection of these conversations.

Representative COLE. It is my recollection that the matter was considered by the members of the committee and the matter was decided as the law was finally written. It was a matter carried to the committee and the committee was made fully aware of all of the facts involved.

Chairman ANDERSON. I think, Dr. Libby, that we should probably recess now until ten o'clock in the morning.

(Whereupon, at 4:30 p. m., Tuesday, February 7, 1956, the hearing was recessed until 10 a. m., Wednesday, February 8, 1956.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

WEDNESDAY, FEBRUARY 8, 1956

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 10 a. m., pursuant to adjournment in the caucus room at the House Office Building, Senator Clinton P. Anderson (chairman of the Joint Committee) presiding.

Present: Senators Anderson (presiding), and Representatives Durham, Price, and Cole.

Present also: George Norris, Jr., and Wayne P. Brobeck of the committee staff.

Chairman ANDERSON. The joint committee will be in order.

I think we can proceed to section 4.

STATEMENTS OF LEWIS L. STRAUSS, CHAIRMAN OF THE ATOMIC ENERGY COMMISSION; HAROLD VANCE, MEMBER; K. E. FIELDS, GENERAL MANAGER OF THE COMMISSION; AND WILLIAM MITCHELL, GENERAL COUNSEL OF THE COMMISSION; AND HAROLD L. PRICE, DIRECTOR, DIVISION OF CIVILIAN APPLICATION

Mr. STRAUSS. Mr. Chairman, I have a suggestion for the expedition of this, which with your permission I would like to submit. It might be desirable to clarify a question which arose with respect to testimony prepared by the Commission for these hearings, and the guidance which we received from the Joint Committee in connection with it because I believe you were a little disturbed yesterday when you returned to the meeting. You will recall that last year, which was the first experinece that we had had under this section, the staff of the committee initiated discussions with us in November as to the type of hearing which the committee intended to hold and gave us some guidance as to the topics which the staff thought that your committee might be interested in having us testify upon. This was confirmed by a letter of January 20, of last year, suggesting, but without limiting us, that certain topics be covered in our presentation.

This year, in order to learn the desires of the joint committee in conducting these hearings, we addressed a letter to the joint committee under date of October 24 inquiring whether the hearings would follow a pattern similar to last year and whether the committee would provide some guidance as to its wishes. Shortly thereafter, members of the joint committee staff met with our staff to review the items that

might be covered in the hearings this year. This assistance was helpful to us in preparing this material, but the staffs did not discuss the volume of possible testimony nor its manner of presentation.

In view of the report of the panel on the impact of the peaceful uses of atomic energy, we were uncertain as to whether the committee would merely desire to hold hearings in connection with this report without prepared testimony from the Commission. We were also uncertain whether in our testimony we would be covering the topics in which the joint committee would be particularly interested in hearing. That was the reason we wrote our letter of February 1 in which we said that in the absence of any specific direction we would present our testimony on the same basis as last year if this were agreeable to your committee.

We regret if the manner in which we have presented our testimony does not precisely meet your preferences. As far as we are concerned it would not be necessary to read the balance of our testimony orally. I suggest therefore, that you might consider permitting us to offer orally some of the introductory material in part IV: Regulations of industry, and then submit to questioning and then present orally section V: International cooperation, and section VI: Raw materials situation and prospects, and that we submit the balance of the chapters for the record briefly highlighting their contents in our oral testimony. We would then be prepared to answer any questions you may have with respect to them or other matters.

Chairman ANDERSON. Thank you, Mr. Chairman. I do not feel it is our function to tell you how this job ought to be done. We have 3 days set aside during which you can present to us and to the American public everything that you think they ought to know about the development, growth, and state of the industry, bearing in mind that we would like naturally to ask some questions. As I look at the volume, it struck me that you could not read what you had here in 3 days much less asking any questions on it. I did not feel that it was the best possible use of the hearing.

You present whatever you wish on it, and I am not trying to be critical of the way it is done. If it had been shorter, we would have probably said or felt like saying that you had condensed it too much. All I am trying to suggest is that it does seem to me that you might present little condensations perhaps on certain of these points, and say that the full statement is here, and that your staff has had a chance to examine it. If you have questions on that we can deal with them, and proceed in that fashion.

Let it just be understood that we are both trying to make a better way of utilizing the time called for by section 202. Whatever you decide to do will be certainly all right with us. However, bearing in mind that perhaps we can work out a process where next years hearings will be a little easier, and each year as they go along.

Mr. STRAUSS. Thank you. The precedent created last year would easily permit of that, because you will recall that a substantial part of the testimony last year was introduced for the record. I would say that one of our difficulties is that these sections being prepared by the interested divisions of the Commission represent the whole aim and goal of the particular individuals. These subjects are not only important but they are particularly important to the men who write them, and condensation, although it has taken place, perhaps could

have been carried further without damage to the facts. We will be guided by the desire not to drag these hearings out interminably, and therefore we will proceed, if you will permit, with section IV, the "Regulation of industry" which will be presented by Mr. Price, the Director of the Appropriate Division.

Chairman ANDERSON. Proceed, Mr. Price.

Mr. PRICE. Mr. Chairman, I will just touch on some parts of this section that we think might be more important, particularly some of the policy decisions of the Commission that were involved in the adoption of these regulations, and some of the reasons for those decisions.

As of now, the Commission has issued eight regulations relating to the licensing program. I will briefly identify them.

They are, first, the Regulation on Licensing of Production and Utilization Facilities, published on January 19 of this year, to be effective February 18.

Then there is the Regulation on Licensing of Special Nuclear Material, published on February 3 to be effective March 4.

Then there is the Regulation for Licensing of Byproduct Material, published January 11, to be effective February 10.

Then there is Operators' Licenses, and this regulation was published on January 4 to be effective February 3.

Then there are Rules of Practice, published February 4, to be effective March 5.

Then there is the Regulation Dealing With Access to Restricted Data, published on February 4, and this one was effective on publication.

Then there is the Regulation on Safeguarding of Restricted Data, published February 2 of this year, effective on publication.

Finally, there is the Regulation Dealing With Unclassified Activities in Foreign Atomic Energy Programs, published January 20, 1956, effective on publication.

There is another regulation pending, which sets standards for protection against radiation which will apply to people who use special nuclear material and byproduct material: This one we are still consulting interested persons and analyzing comments. It ought to be issued within the next few months.

The existing regulation on control of source material is being revised.

Now, each of these regulations, of course, incorporates certain statutory provisions that are applicable. They generally prescribe information wihch must be submitted by applicants for licenses, and they state the criteria for approval or disapproval. Basically, all of them require that the licensee or his staff have suitable training or experience to possess and use the material or facility, that he have equipment and facilities appropriate to protect health and minimize danger to life and property, that the location of the proposed use is suitable for the purpose, that he will use the material or facility only for authorized purposes, and that he will not transfer the facility or material except to another licensee authorized to receive it.

Now, for the most part, we have not attempted to state precise requirements with respect to these various matters, particularly in the case of the procedures which an applicant or licensee will follow to comply with the safety requirements. We have asked him to state

his proposed procedures and then the Commission will include applicable requirements in the particular licenses.

Although the various regulations have some basic provisions that are common to them, there were some problems in connection with a few of the separate regulations that I would like briefly to touch upon.

In the case of the regulations dealing with the licensing of production and utilization facilities, of course, the first problem that the Commission had to determine was the definitions of facilities that would be subject to the regulations. Within certain limits this matter was left by the statute to the discretion of the Commission. What we have decided in this case is that we will license as production facilities all nuclear reactors designed primarily for the formation of plutonium or U–233. Other reactors will be treated as utilization facilities.

Chairman ANDERSON. They would not be licensed?

Mr. PRICE. They would be licensed, yes, sir; and actually the rules under the law so far as the licensee is concerned are substantially the same. I think perhaps the difference between utilization and production facilities might be important in terms of some other provisions of the statute but so far as the licensing requirements are concerned, the health and safety problem and the security problem are the same in both cases. That is also true of the rights of the licensee to engage in the business.

Other production facilities would of course include facilities for isotope separation and facilities designed for processing or irradiated materials containing special nuclear materials, such as chemical processing plants.

Then we would treat as a utilization facility any nuclear reactor other than one designed primarily as a production facility for the production of plutonium or U–233.

As finally issued, the Commission decided not to subject to facility licensing so-called fuel element fabrication plants. The reason here was that the hazards problem and the safety problems in connection with these facilities, or these types of facilities, are fairly straightforward and we felt that they could be adequately handled under the licenses that the company would have to get to possess the special nuclear material anyway. This would just save an extra licensing procedure.

Chairman ANDERSON. When you mentioned health and safety now, are you going to handle that unilaterally by the Atomic Energy Commission or will that be in cooperation with the States?

Mr. PRICE. Sir, we are making every effort to cooperate with the States to the end that we and the States, to the extent that they decide to have safety regulations, will adhere to a common standard and try to avoid conflicts between the standards that we will adopt and the standards that the States might adopt.

Chairman ANDERSON. You will set one set of standards then, and they will have another set of standards?

Mr. PRICE. I do not know whether they will or not, Mr. Chairman. We will have to set standards in these regulations. We started working with the States last summer in an attempt as far as possible to get not only their views but to see if we could not achieve some standards

that would be acceptable to the States in the sense that they would not pass regulations that might be in conflict.

Chairman ANDERSON. But you say now that you are going to set the standards in the absence of any State standards, and presumably if the State standards come in you will both set standards. How will they be enforced? This is health, inside a State, and do you think that you can enforce it?

Mr. PRICE. Sir, I think that we are perfectly clear that the Atomic Energy Act requires us to impose regulations relating to hazards and other health and safety problems that are peculiar to this industry.

Chairman ANDERSON. And therefore it would be your province to enforce it?

Mr. PRICE. That is right, sir.

Chairman ANDERSON. Do the States agree with that?

Mr. PRICE. They do not disagree that the Atomic Energy Act has given this responsibility to the Commission, and I think generally it is fair to say that the States are looking to the technical people in the Commission program to lead the way.

Chairman ANDERSON. I am not a lawyer, and I probably should stay out of this, but someone has written a book about the forgotten ninth amendment, which reserves to the States all powers not expressly granted to the Federal Government. Do you believe there is a grant to the Federal Government to enforce health and safe regulations?

Mr. PRICE. I was not attempting to pass on the constitutional question.

Chairman ANDERSON. You have to do it now whether you are doing it constitutionally or not.

Mr. PRICE. I assume the Atomic Energy Act is constitutional. It gave this responsibility to the Commission. It seems to us that the hazards problem is the important problem to be dealt with so far as any need for licensing of these facilities is concerned.

Chairman ANDERSON. I do think it is a field where very close cooperation with States might be necessary. The Federal Government might pass a law that there could be no segregation in schools, and you might find 1 or 2 governors who would resist that.

Mr. PRICE. We also feel that cooperation is important. As a matter of fact, last summer we had a meeting at which we invited all of the 48 Governors to send their health and safety people to a meeting here. We had a 2-day meeting, and canvassed this problem with them. Since then we have established an advisory committee of State officials, about 12 or 14 of some of the leading State health officials, and State labor officials that are involved in this field. We are having a meeting with them in the next couple of weeks to go over this regulation that I mentioned awhile ago, the standards for protection against irradiation that set the levels of exposure, and so forth.

Chairman ANDERSON. I do not think it is contrary to public policy for you folks to take the lead in it at all. I think it is very sound public policy for you to do so. The average State official has a great deal of difficulty knowing what standards to set up and what levels to guard against, and so forth. On the other hand, I think that there will be some States that will strongly defend their rights to have something to say in this field. I feel the only way out of it is the way you have indicated that you are proceeding; namely, by a conference with

these State groups. The question is a live one, because some State people have written in asking for the introduction of special legislation to make sure that the Atomic Energy Commission does not get out into this field.

Mr. STRAUSS. Of course, the obvious situation here is that the hazards would not stop at State lines.

Chairman ANDERSON. Well, I think that is true. But that does not always stop States from feeling they have rights. Have you made any progress in drafting a uniform State law that might be suggested to them? You know there have been many efforts made to try to get uniformity. I believe now all of the license tags that go on automobiles are going to be the same size this year, probably for the first time after years and years. They finally have a uniform regulation. Perhaps they have not, but I thought they did have. But if you had a uniform law that you could suggest to them they might take it a little more quickly. Have you made any such plans as that?

Mr. PRICE. No, sir; we have not. As I say, our standards on exposures in such matters we propose to incorporate in a regulation were developed on the basis of the work that has been done over the past 25 years in this area, by the National Committee on Radiation Protection, and other authorities in the field.

I think to the best of my knowledge, the few States that are actively considering regulations of this character have been following the same standards. As of now, I do not think that there is any immediate problems of conflict and inconsistency. The fact is that very few of the States are considering moving into this field in the near future to the best of our information.

Chairman ANDERSON. You do not think it would be desirable to lead the way by telling them what seemed to be desirable characteristics of the health and safety laws in reference to this field?

Mr. PRICE. Mr. Chairman, I think we will be doing that when we issue our regulations based on advice that we get from the State officials and other people qualified to advise us in these matters.

Chairman ANDERSON. You have just the reverse of what I am suggesting might be a more pleasant way to handle it. You are going to issue your regulations unilaterally?

Mr. PRICE. I think that we are required to, and we cannot avoid that responsibility.

Chairman ANDERSON. I do not say that you should avoid it. But is there any reason why you should not at the same time try to find out if the States would be willing to cooperate with you? They may not like it, to have you just hand down a set of regulations, and say, "This applies," because they may feel they have some rights in the field of health.

Mr. PRICE. That is right. We are doing that, and the 1 or 2 States that have issued regulations have worked with our people in soliciting our help in the development of their programs.

Chairman ANDERSON. Mr. Durham had a bill, I believe, relating to the States in this field, did you not? What was your reaction to that?

Mr. PRICE. Mr. Chairman, I received it a week or two ago, and I do not believe that I would be prepared at the moment to comment on it.

Chairman ANDERSON. What study was made of the bill?

Mr. PRICE. I personally have not given it enough study up to now to warrant comment on it.

Chairman ANDERSON. Have you seen it?

Mr. PRICE. Yes; I have read it.

Chairman ANDERSON. How do the provisions sound?

Mr. PRICE. I would like to have an opportunity, Mr. Chairman, if it is agreeable to you, to give it further study before expressing an opinion on the merits of it.

Chairman ANDERSON. When did you introduce it?

Representative DURHAM. 2 weeks ago.

Mr. PRICE. I do not know whether it is the right thing or not, and I would like to consult with some other people on it and study it.

Chairman ANDERSON. That is the very heart of this question this morning, is it not? That is what Mr. Durham has proposed.

Mr. PRICE. As I understood the bill, it would, in effect, transfer all of the health and safety responsibilities to the States as fast as the States decided they could handle it.

Chairman ANDERSON. Precisely, that is what we are trying to get to. If you are not going to report on his bill, then of course Federal regulations will probably continue. Do you feel it is more desirable to hold on to this, or if the States are ready to move in the field, to let them proceed?

Mr. PRICE. On one point, Mr. Chairman, I would question that the States are ready to take over the hazards-evaluation matters that are involved in licensing of power reactors, and that is health and safety.

Chairman ANDERSON. If the Congress passed the bill indicating that it thought they were, and the States agreed with it?

Mr. PRICE. That would be different.

Chairman ANDERSON. What would be the situation.

Mr. PRICE. That is right, there would be no requirement upon us to regulate in this field.

Representative DURHAM. Of course, I realize it is a very broad question and one that would affect your water pollution and everything else in the States, and in some States at the present time you have very strict regulations on your streams already under their own State public health laws. The whole idea was that we might run into conflict somewhere. If we could work this out on an agreeable basis, my whole idea of the thing was that we could. It was not to immediately put into operation such a thing without the advise and the counsel and everything that we have to give to the States through the Commission. That is a question that is going to require a good deal of study and the public health officials of the States should be interested in this thing at the present time.

Mr. PRICE. I am sure that the Commission will want to study this bill and report to the committee its views on it.

Representative COLE. It would seem to me, as long as the Government in the owner of the special fuel elements in all of these reactors, I do not see how the Federal Government can be relieved of its responsibility in the field of safety and health. It cannot turn it over, lock, stock, and barrel, to the States to handle it. That is true as long as we, the Federal Government, own the special fuel. That is a big problem. It requires a lot of thought and study.

Chairman ANDERSON. I do think it is a field where you are going to have perhaps some conflicts in jurisdiction, and it did seem to me wise, that before the regulations are issued, that it might be well to try to find out what all of the States think. You say 1 or 2 of them are in

that field. All 48 of them are going to have problems. Certainly, the disposal of atomic wastes might involve the question of sanitation, might it not?

Mr. PRICE. That is right.

Chairman ANDERSON. Do you regard it as a Federal function to decide whether drinking water is pure in a community?

Mr. PRICE. I suppose it is not. Our responsibility there would probably attach only to the person that we had licensed, and our problem here would be to see that our standards and regulations do not permit him to put quantities of dangerous material into a stream or to put quantities in, in excess of safe limits.

Chairman ANDERSON. I agree with that, you see. And that therefore involves, I think, some degree of cooperation between you and the State people, whereby you say we are doing something so that you would not have to worry with that problem and then, you have your own function.

Mr. PRICE. We are entirely in agreement on the importance of cooperation with the States. Moreover, we have made arrangements to keep the States fully informed on all licensed activities. We undertake to notify the State officials when we get applications for licenses for plants in their States, and we intend to keep them informed upon the issuance of licenses. We have invited them to give us any advice or comment they care to in connection with pending cases.

We have made an effort to see to it that they are in touch with the companies that are dealing with us. The States will be fully informed as we go along.

Chairman ANDERSON. I do not intend to press it. I just thought that it might be desirable at some point to have some sort of a conference with the State health and public safety people to see if they were interested in getting the suggestions of the Atomic Energy Commission for a model law that might or might not be passed in one or the other of the States. I think it would help the whole situation if the legislation could be somewhat uniform, and they are certainly short of material to know how to proceed at the present time.

The only source of responsible guidance they could have would be the Atomic Energy Commission, it would seem to me.

Mr. STRAUSS. As Mr. Price testified a moment ago, we called a conference which was attended by representatives of all of the States, and it may be time in the very near future to have a second go around based upon the progress that has been made in the interval.

Representative DURHAM. The proposed regulations on the standards of protection, has that been mailed to all States for their comment?

Mr. PRICE. Yes, and we have received comments from a good many of them.

Representative DURHAM. You have had no adverse comments on it so far?

Mr. PRICE. Not adverse comment on the question of whether such a regulation is needed. We have received a lot of helpful comments from technical people and other people upon the details and suggestions for revisions. Of course, that was the purpose of publishing it for comment, to get all of the help we could in working out the details.

Chairman ANDERSON. Have we had them? Has the Joint Committee had them?

Mr. PRICE. I think all of the proposed regulations have been sent to the Joint Committee prior to publication in the Federal Register. This regulation is not in effect yet, and it was published in the Federal Register last July. And I would be greatly surprised if the committee did not get it prior to publication.

Chairman ANDERSON. It has been published in the Federal Register, and we are put on notice regarding it.

Mr. PRICE. It is our practice, sir, to send you a draft of it prior to publication.

Mr. STRAUSS. It would be an oversight if it had not been done.

Representative COLE. Do you think it has been an oversight?

Chairman ANDERSON. It has been received.

Mr. NORRIS. We have received it. It was a July date that I did not recall.

Chairman ANDERSON. Proceed, Mr. Price.

Representative COLE. Before continuing, now that we have had the interruption, and since we have completed the discussion of the health aspect, getting back to the question of licenses, Mr. Price, how long does it take on an average to process an application for a license?

Mr. PRICE. Mr. Cole, it depends on what the application is for. Licenses for byproduct material and source material are almost handled overnight in the normal case. In the new areas that we are going into—licensing of facilities—this takes longer.

Representative COLE. That is the type of license that I had in mind, production facilities.

Mr. PRICE. We have no strictly production facilities applications pending. We have a lot of what we call utilization of power reactor applications, and a large number of research reactors. We have issued construction permits on various research reactors, and some of them have been completed and have been converted to licenses as the statute provides.

At the end of this material there is a chronology of the status of each of these applications.

Representative COLE. You do intend to show for the record the number of applications for licenses in various categories, and the status of them?

Mr. PRICE. The big ones we have listed by name, and we have summarized the little ones, the byproduct ones.

Representative COLE. Do you show the number of applications pending?

Mr. PRICE. Yes, sir.

Representative COLE. That would also be shown, the ones granted.

Mr. PRICE. Pending and granted, yes. Basically, on a facility license, Mr. Cole, the question of how long it takes to issue the license depends on how long it takes the applicant to develop the particular technical information needed to satisfy the Commission and its advisers with respect to the hazards problem. Now, most of these people, in fact all of them that have applied for facility licenses, have applied before they had even developed their design, before they had completed some tests that they will need to run in order to satisfy themselves on the hazards problem.

The applications in that respect are all incomplete.

Representative COLE. Have any applications been refused?

Mr. PRICE. Not for facilities, no, sir.

Representative COLE. What kind of applications have been denied?

Mr. PRICE. I suppose an occasional application for isotopes gets refused in the sense that additional information will be called for with respect to the applicant's capability and facilities for safe handling, and for one reason or another he may decide not to press the matter.

Representative COLE. May we understand that no application for a research facility or other type of facility has been denied?

Mr. PRICE. No application for any type of facility has been denied.

Representative COLE. All right.

Chairman ANDERSON. Will you proceed.

Mr. PRICE. There is a point that relates to your question, Mr. Cole, and it is on the hazards. The big problem we have in connection with facility licenses is in this area. The fact is that at the present stage of development, as you know, each of the reactors planned for construction is substantially unique. There are technical problems, hazards problems associated with each of these reactors on which answers have not yet been developed. This has made it impracticable for the Commission to prescribe in its regulations definitive standards relating to hazards evaluation. What we have done is to set up a procedure under which applicants can make their preliminary submissions to the Commission and then we would, so to speak, work along with them as fast as we are satisfied that the general design concept and the location of the facility appear to be all right. We would go ahead and issue a construction permit as the statute permits, which would have to be conditional, of course, conditioned upon their satisfying the various hazards problems that they will have to deal with.

Very often this means that they have experimental and testing work to do. As fast as they complete that work and submit it to us, it can be approved and then the construction permit will mature into a license.

The way the companies go about this, it is pretty clear that all of those matters will not finally be resolved until about the time the reactor is going into operation, because their designs will change, and they will run tests. But this will work out all right because, to the extent that the companies are satisfied that they can work out the answers to the hazards problems they develop, they are perfectly willing to go ahead with these conditional construction permits.

Chairman ANDERSON. May I call your attention to the fact that you have been mentioning many times health and safety factors. Now, when you set up your standards, in addition, you will take into consideration the health and safety standards, and are you not required to take into consideration the common defense standards?

Mr. PRICE. Yes, sir.

Chairman ANDERSON. You have not mentioned very much about that.

Mr. PRICE. The point is covered; yes, sir.

Chairman ANDERSON. Thank you.

Mr. PRICE. The facility licensing regulation adopts two classes of licenses that are based on the provisions of the statute. The class 103 license is named for the section of the statute that authorizes licenses for facilities of types found by the Commission to have been sufficiently

developed to be of practical value for industrial and commercial purposes.

Chairman ANDERSON. Where are you now?

Mr. PRICE. I am talking on page 11 of the report, sir.

Then there is the class 104 license, that is the license for facilities used in medical therapy or research and development. And then the so-called 104 (b) facilities, which are the facilities for research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. This, of course, includes all of the power reactors that are under consideration by private industry.

There is a point in connection with these power reactor facilities that I would like to mention. The statute provides that in issuing licenses for facilities of this demonstration type, the Commission shall give priority to those activities which will, in the opinion of the Commission, lead to major advances in industrial or commercial application of atomic energy.

The Commission believes that this, in effect, is a priority or preference provision. It is our belief that this preference provision would need to be applied only in case of a shortage of special nuclear material or anticipated shortage. Recognition of this is given in the regulation with the result that the fact that an applicant proposes to construct a power reactor under section 104, demonstration type, which duplicates a facility already in operation, would not be considered as a ground for denial of the license.

Now, this was touched on yesterday in connection with financial assistance. Whether the Commission would financially contribute to duplicate facilities is one question. But so far as licensing is concerned, where the company is putting up its own money, we see no reason to deny licenses for duplicate research and development facilities so long as the material holds out, and so long as there is no problem of material shortage.

The statute requires the applicants to furnish the Commission certain financial data. As the regulations have been issued, prospective licensees are required to make a showing that they are financially able to pay the use charges on special nuclear materials that they obtained from the Commission, and the value of material consumed in process or lost. The Commission considered but has not yet acted upon a problem that is related here, and that is whether or not applicants should be, in connection with their financial ability, required as a matter of regulation to satisfy the Commission that they have sufficient financial ability to pay claims for damages which might result from operation of the facility. This relates, of course, to the insurance problem, but in this context it is a separate question. That is, should we require a showing of ability to meet X dollars worth of claims? The Commission has under consideration whether this kind of requirement should be added in the regulation.

Chairman ANDERSON. Right on that point, how can the Commission make an affirmative decision to require proof of the financial ability to pay claims for damages, if there is an absence of adequate insurance available?

Mr. PRICE. That is a part of the problem, Mr. Chairman. Of course, if the Commission imposed this kind of a requirement, it is conceivable,

and I should think probable, that the amount of insurance that the Commission would insist upon as a minimum might be something less than a maximum possible loss.

Representative COLE. If the Commission insisted on a showing of financial capacity to meet all damages, all possible damages, I doubt if you would issue any licenses at all, would you?

Mr. PRICE. I would not think that it would be that order of magnitude.

Representative COLE. You might as well not even start, if you are going to require that.

Mr. PRICE. That is right, but the Commission is, as I say, considering this, as to whether some minimum amount ought to be imposed as a matter of prudence.

Chairman ANDERSON. Was not the real purpose of that section of the law to make sure that the operator of facilities or the user of materials would not skimp on health and safety measures, and common defense measures? We were not trying to make sure we would be able to pay all possible damages in the law.

Mr. PRICE. The regulation does not get into the question of his ability to pay damages. As it is now written, it deals only with the question of satisfying the Commission of his financial ability to carry out the project, which would include carrying out the safety measures, and his financial ability to be able to pay the Commission for the burn up of material and the loss of material that takes place.

Chairman ANDERSON. Then the insurance problem is not a matter that will worry the person who is seeking to have the issuance of a license unless the person is possessed of enough other means so that he would face a claim for damages of a sizable proportion? As far as damages are concerned, if he has enough money to build the plant, and pay for the nuclear material, that is all you are going to worry about in the license.

Mr. PRICE. As the regulations now stand, that is all that he would have to worry about. Of course, he still has the big worry as to whether enough insurance is available to protect his assets. That is a separate question.

Chairman ANDERSON. But we have a corporate form of organization that he can rely upon that will limit his capitalization to exactly what he has put in the plant. Conceivably, if he had an accident, what he has put in the plant would probably vanish. That would be all. It would seem that you might think about the possibility that he ough to be able to obtain some sort of insurance coverage.

Mr. PRICE. That is the problem we have not resolved, yes.

Representative COLE. Does the law require you to make sure that the applicant has financial ability to carry out the program. It seems to me it is in the law.

Mr. PRICE. I think, or it is my understanding, that the Commission does have authority to get sufficient financial data to assure itself that the applicant will be able to live up to the requirements of his license, and will be able to pay the Commission for any material that he loses or burns.

Representative COLE. I see the law does require the applicant to show or make a showing to the Commission of the applicant's financial qualifications. That is a very broad and indefinite and ambiguous expression.

Mr. PRICE. That is right.

Representative COLE. Your concern is whether the possible liability to damages for unexpected reasons is a facet of the financial qualifications.

Mr. PRICE. That is the problem we have not yet resolved.

Representative COLE. I can only say from my own standpoint, the question of financial capacity of the applicant to meet possible damages never entered my mind, but I thought the Commission ought to look into his financial qualifications. It was that the Commission be satisfied that the applicant has enough money to carry out the program. That is the affirmative part of the program, and not anticipating the harmful effects.

Chairman ANDERSON. I do think that is an important point. We understand, and we are trying to make sure we understand each other. We understand that as far as the license is concerned, and as far as you will go is to make sure the applicant has sufficient financial ability to build the plant and to build it in such a way that health and safety factors are fully protected, and it does not jeopardize the common defense.

Mr. PRICE. That is the present status of the regulation.

Chairman ANDERSON. You do not go beyond that to say that he must be able to make satisfactory assurance he can pay claims for damages. Frankly, I do not see how you could go beyond that, but that at least is your statement, is it not?

Mr. PRICE. Yes, and on that point the Commission has merely reserved judgment as to whether at some future time it will impose a minimum amount of insurance as a condition of issuing the license.

Representative COLE. What is the liability of the Federal Government with respect to damages in the operation of the licensee?

Mr. PRICE. I am not sure I can answer that question. I do not think that I know. There is a provision in the statute that requires licensees to hold the Federal Government or the Commission harmless from any losses that might occur. But I do not know what the Commission's liability is in the first place, or whether there is any. It is true that under the statute the licensee has to agree to hold the Commission harmless.

Representative COLE. That is a stopgap, and that is some help. But, Admiral, do you want me to ask you the question, of what is the Commission's view, or Mr. Mitchell?

Mr. STRAUSS. I would rather you asked Mr. Mitchell, but I would like to contribute to this a very short and very cogent paragraph from the report of the Joint Committee's Panel on the Impact of the Peaceful Uses of the Atomic Energy.

It reads as follows:

The Atomic Energy Act——

Representative COLE. Could we have the page?

Mr. STRAUSS. Page 24, section 1, 1.3.5:

The Atomic Energy Act of 1954 requires licensees to assume full liability for any damage resulting from licensed private activities. The Commission has no discretionary authority in this area. As peaceful uses of atomic energy reach a stage of technological development sufficient to permit commercial applications, the economics of such applications will come to depend in some measure upon the actions required to insure against potential hazards to safety and public health. Adequate knowledge of these hazards has not yet been fully developed, especially

with regard to long-term effect of radiation, and radioactive contamination of humans, animals, and croplands.

The risks entailed in peaceful uses of atomic energy are thought by some prospective private licensees and insurance companies to be greater than can be covered by normal insurance. Exploration of ways of guarding against extremes of public liability and of means of assuming the full extent of such risks is in progress.

That is the end of the quotation, and the implication of it, it seems to me, is that this whole consideration is in its infancy, and there is very little that can be said except that we are feeling our way.

Representative COLE. That is what I am curious to know. What is the present status of your feeling? Is the Federal Government liable for any deficit which a licensee is unable to meet?

Mr. STRAUSS. I do not believe so. I would like to have counsel reply to that question.

Mr. MITCHELL. Mr. Cole, as you stated the question, it seems to me the answer is, "No." The Federal Government is not liable for any damages that might be incurred by a licensee over and above those to which it is able to respond itself. Now, of course——

Representative COLE. What is that again?

Mr. MITCHELL. If the licensee—let us say there is an accident in a licensed facility, and the licensee is not financially able to pay all of the claims, as I understood it, what you are asking was, would the Federal Government have to pay the balance?

Representative COLE. That is right.

Mr. MITCHELL. The answer to that is that it would not.

Representative COLE. Is there any doubt in your mind?

Mr. MITCHELL. No, sir. Now, I think that I should add this, that, of course, under the Tort Claims Act, if the Federal Government or any of its employees or agents have been negligent, then there is a basis for a claim against the Government. But there is a further limitation on that, that if the Government was acting in the exercise of a soverign discretion, and this is the doctrine of the Texas City case, then the Government is still not liable.

Chairman ANDERSON. The Government is still not liable?

Mr. MITCHELL. No, sir.

Chairman ANDERSON. You recall, of course, that the Congress just got through appropriating millions of dollars in the Texas City case, liable or not.

Mr. MITCHELL. I am talking now in the context of legal liability as a matter of enforcement of a right in the courts.

Chairman ANDERSON. Well, could the claimants not come back and insist that if the Atomic Energy Commission had been more circumspect, and we are talking about hypothetical cases now, in its examination of the licensee and not granted the license for the construction of the type of reactor that blew up, there would have been no damage, and therefore, the Federal Government might be a party to the subsequent action? The point of the law is that there is a provision with respect to this licensing that finally gets down to section 8, on page 14 of the law, which says—

the licensee will hold the United States and the Commission harmless from any damages resulting from the use or possession of special nuclear material by the licensee.

Therefore, the presumption is there that the United States might be a party to some sort of suit. In determining the rights of the

man to a license, one of the conditions that you are going to lay down upon him is that he must agree to hold the United States and the Commission harmless from any damages resulting from the use or possession of special nuclear material. Can that be done with the ordinary financial statement or does he not have to have something behind it?

Mr. MITCHELL. Senator, I assume that there is some possibility at least that it could be proved that in a particular situation some Government official or employee had been negligent. Then you get to the question of whether, if this was in connection with the issuance of a license, whether the issuance of the license itself is not an exercise of sovereign discretion. I do not know what the answer would be.

Chairman ANDERSON. It would be pretty rough, but there are a great many people who are very much interested right now in this question of whether they need to have insurance before they begin to operate a reactor. And they are interested in what the possible limits of that insurance might be. I believe there was some announcement that one group of stock companies had figured they might be able to take up to $50 million.

Mr. MITCHELL. Yes, sir.

Chairman ANDERSON. Now, is it going to be a policy to require that they avail themselves of what is in the market, even though it may be inadequate to a complete catastrophe, but thereby try to protect to the degree they can adjoining life and property? It is a question that the Commission is probably going to have to decide, but it did seem to me that the law indicated that they expected the Commission to try to make sure that this licensee did whatever he could to protect not only the Government but the Commission from any claim that might be made as a result of this.

Representative COLE. It seems to me that this question of insurance is one of the most important in the whole field of licensing with respect to the progress of this business. If the applicants are going to be exposed to the liability in the extreme of a calamity, they are going to be discouraged from getting into it. Frankly, that was one of the angles of the atomic problem that I hoped and expected the panel would undertake a study of. Their findings on that in that respect leave me right about in the same position I was in when we started out. It was of no help at all. It just seems to me that it is a subject which either the Commission or the Joint Committee or somebody has got to take a hold of. We have to find some solution, unless everybody is agreed that the probability of accident in an atomic reactor is so very remote that we do not need to be concerned about a catastrophe. When you encounter such a person as that, Mr. Price, or Admiral Strauss, I wish you would send them around. I would be very much heartened to learn that.

Mr. PRICE. Well, the insurance problem is a hard one to come to a conclusion on for a variety of reasons: No. 1, the amounts of insurance on public liability, including third-party liability, that the insurance companies have recently indicated that they will be able to write are fairly substantial. I am told that they are considerably in excess of any amount of insurance that other types of industries or companies in other types of industries buy. They are talking about a figure of a total of $60 million per plant for the public liability insurance, and around $50 million for the plant itself.

Now, the difficulty is that some of the manufacturers that are worried about third-party liability are really urging what amounts to an open-end hold harmless. That kind of gets it out of the context of insurance because they are talking about protection against the maximum possible loss. Normally, insurance is not bought on that basis, it is bought on probabilities.

Chairman ANDERSON. Let me ask Mr. Mitchell or you to comment on this: If I possess an automobile and some other person takes it and drives it and becomes involved in a very serious accident in which there is loss of life and tremendous damages, no one attempts to collect it all from the man that happened to be driving the car. They come back to the owner of the automobile.

Now, in this plant, the plant may have been designed carefully by good engineers, and may have been built to standards which the Atomic Energy Commission feels to be wise, but the material which blows up will be owned by the Federal Government, will it not?

Mr. PRICE. That is right.

Chairman ANDERSON. And the Federal Government will be the owner of the nuclear material, and therefore, the claims for damages—I do not say properly, but I say conceivably and, I think almost inevitably—will come against the Government of the United States, the owner of the material which blows up and causes the damage. That is why, perhaps, this clause is in there that he shall save harmless the Government.

Mr. PRICE. May I ask Mr. Mitchell to respond to that?

Chairman ANDERSON. Do you not think there is a responsibility of the Federal Government when it owns the material which explodes but may not own the vessel on which it explodes?

Mr. MITCHELL. If you are talking moral responsibility.

CHAIRMAN. Anderson. I am not talking moral responsibility, I am president of a small insurance company, and every time we insure an automobile I know that it does not matter who drives it, if the owner of the car has some financial liability he will be in the case before we get very far.

Mr. STRAUSS. May I interrupt before counsel responds to that? You have asked him for an opinion, and I was wondering whether this testimony might at some future time be invoked in such an action.

Chairman ANDERSON. I do not know why. People are trying to build reactors, and they are wanting to know what their responsibility is going to be, and the people living next to them. They are beginning to ask these questions. We are in an unusual situation. We do not sell the man what he is going to put inside that reactor. If the Federal Government transferred title to him, then the Government would be relieved of that liability. But since the Government is going to retain title to the nuclear material, is it not the Federal Government itself that is the first and immediate victim when the suit is filed? I do think that that is a question. If the Chairman feels that it is jeopardizing future defense, we will not ask it.

Mr. STRAUSS. I was raising it for your consideration, Mr. Chairman. Whatever you decide, we will comply with.

Chairman ANDERSON. We cannot get to the question of whether we need to take some precautionary step until I have had it developed. I have had an individual who was considering a license say, "Well, my company has X million dollars in assets. If we build a reactor we are

going to have to put it in a new corporation because all we can get is $50 million of insurance, and the claim conceivably could run into hundreds and hundreds of millions of dollars."

I will not use the terms he used, because they sound big. But conceivably there could be a very large claim. Does that claim come only against the operator, in which case he would pay as far as he could go, and then fall back on the insurance company, or fall back on the other, and then does it go to the insurance company which has insured up to so many millions of dollars, perhaps $50 million? And if the damage is above that do we just say, "Well, it is just too bad, we have paid as far as we can go and that is the end of it," or is there a suit against the Federal Government?

I raise that question because—we are not to it yet, but as the reactor begins in operation in 1957 at Shippingport, and 1958 or 1959 some place else, pretty quickly we move into it.

Mr. STRAUSS. The only think I was apprehensive of was the expression of a legal opinion from Commission counsel.

Chairman ANDERSON. How can we live without the opinion?

Mr. MITCHELL. I do not think that there is any difficulty, because my opinion is going to be that the Government is not liable.

Mr. STRAUSS. I am relieved.

Representative DURHAM. Do you not accept the hazards when you grant the license? Does not the licensee accept the hazards when the license is granted by the Commission?

Mr. MITCHELL. I think, Mr. Durham, and Mr. Chairman, that the point is this: The Federal Government is liable in court only to the extent that it submits itself to liability. This is a doctrine of sovereign immunity. Now, the Congress has subjected the Federal Government under the Tort Claims Act to liability where there is negligence. So the only area, and this is right across the board, in which the Federal Government could be liable would be if a Federal official or employee or an agent could be shown to have been negligent. This doctrine is further limited by what the Supreme Court said in the Texas City case, that if the activity is in the exercise of a governmental function where sovereign discretion is involved, then, even so, there is no liability.

Chairman ANDERSON. That is a very interesting answer, and a very good point, and I will not attempt to pass on how good it is. Some court may be called upon to do that, but it sounds very good to me, and I am very happy to have it, because I think that it clears up a portion of this problem. That is a good answer.

Representative COLE. Mr. Mitchell, what is your opinion with respect to the authority of the Congress to limit the liability of a licensee to meet damages and claims which might occur in the operation of the facility?

Mr. MITCHELL. I am sorry, Mr. Cole, I am not prepared to address myself to that. I have not given it any study. I think offhand I would have some doubt, but I am not sure.

Representative COLE. The reason I asked it: That has occurred to me as being, if it is constitutional, one possible solution to this insurance problem. That would limit the liability.

Mr. MITCHELL. Yes, sir.

Representative COLE. And I suggest that you might give it some thought.

Mr. MITCHELL. All right, sir.

Representative COLE. We might have to grapple with the insurance problem sometime soon. The sooner we get a solution, the better.

Representative PRICE. Mr. Chairman, may I add my little say to this matter of insurance, because I think every member of this committee knows that this is foremost in the thinking of many of the industrial participants in the program. It is true of some of them to the extent that they feel that it may delay their participation in some way.

I have been interested to the extent that in recent weeks I have been in contact with the Commission and asked a more serious study be given to the matter of insurance. I have requested members of our staff to get a little deeper into the thinking of the third-party angle to the insurance. That is the one that gives the cause for concern. I think arrangements are being set up to take care of normal-hazard risks and, as we pointed out yesterday, we had no instance of any major catastrophe in all of our work through the years on reactors.

The first catastrophe could come, but we have never had any instance of any, and the safety record of the atomic-energy program has been better than normal situations in the industry. I think the safety record has been remarkable.

I think the matter is serious enough that this committee should hold a separate hearing sometime, and probably very soon, to see if we cannot in some way resolve this insurance matter. It is very important. I know of its importance because I have talked to industrial participants in the program and I know what they are thinking about the matter, and I know that it does in some way retard their participation at this particular moment in the program.

I hope the committee can set aside a special meeting or hearing on this particular matter.

Representative DURHAM. I might suggest also, at this time, that the Congress now is looking into disaster insurance, which is somewhat similar to the problem we face. It might be well for you to look into that and see if you could become a part of it, if necessary.

Mr. STRAUSS. We would welcome the opportunity of such a hearing as Mr. Price proposes, Mr. Chairman.

Representative PRICE. I am one of those who personally feels that the future will disclose there is probably never any cause for our concern or worry on this matter, but we cannot be certain of that.

Representative DURHAM. All right; will you proceed, Mr. Price?

Mr. PRICE. There are a few points that perhaps I might mention in connection with the licensing of special nuclear material and a few of the other regulations which might be mentioned. I think, in connection with the licensing of special nuclear material, I would like to mention two points. In this regulation the Commission had, as one of the major problems to consider, the problem of the extent to which the Commission should impose detailed rules for accountability of material and rules with respect to the guarding and safeguarding of material. These are matters that get close to the management of the company's business. They are matters that could conceivably, under a detailed and rigid regulatory procedure, become expensive.

Now, of course, in the Commission's own program we have for years maintained detailed accounting systems for special nuclear and other materials. We felt that the advantages to be gained by this system in protecting the Government supply of this expensive and strategic

material were well worth the expense and inconvenience to the Government of maintaining the system.

However, in this regulation we have not imposed this detailed system upon licensees. Neither have we attempted to tell them how high their fences need to be, and how many guards they need. It was the feeling that the financial responsibility of the licensee for the loss of this valuable material and the severe criminal sanctions for unlawful diversion should provide sufficient incentive to assure adequate protection and accounting for the material. I should mention parenthetically, of course, that this is unrelated now to the problem of restricted data. As to any quantity of material that is classified because of its configuration or content, of course, the requirements for the safeguarding of restricted data would be fully applicable.

The regulation does require each licensee to maintain records showing his receipt and inventory and transfer of special nuclear material and he is required to make periodic reports, and, of course, he is subject to inspection.

Representative COLE. Does the Commission still maintain the strict accounting system?

Mr. PRICE. I do not know whether I can give a full answer. It is the procedure, and it has from time to time been modified, and there is still an accountability system in effect, of course.

Representative COLE. But not as minute and in as great detail as it was in years past.

Mr. PRICE. I believe that is right.

Representative COLE. So that if somebody should suddenly discover that a multimilligram of some material is missing, we are not going to throw ourselves into a tailspin.

Mr. PRICE. That is correct.

Representative COLE. I am glad to hear it.

Mr. PRICE. There is perhaps one other important point in connection with the materials licensing. The regulation, in accordance with the statute, provides that we will include in licenses an allocation of special nuclear material for the period of the license. This normally will apply in the case of the reactor licensee. He will, of course, need to have assurance at the beginning that this material which the Government has to own is going to be available to him as he needs it. So we propose to set up allocations to each of the reactor owners and distribute the material to them as needed. The other licensees will not need an allocation normally; that is, people such as fuel-element fabricators and chemical processors. To the extent that they have customers they will get the material, because there will always be this allocation in effect to the consumer, the reactor owner.

I might just very briefly mention the other regulations. The By-Product Material Regulation, in its recent revision——

Representative COLE. Before you come to that point, my attention has been called, on page 17 of your statement, to the point there where you refer to the insular possession known as Puerto Rico, as the Commonwealth of Puerto Rico. I would call to your attention that there is no such title attached to that insular possession, as far as the Federal Government is concerned. I would suggest that you refer to Puerto Rico as Puerto Rico. It is true that, I guess, the Puerto Rican Government has given itself the name of "Commonwealth of Puerto Rico,"

but the Federal Government has not done so. It is not the status of a commonwealth as yet.

Mr. PRICE. I was under the impression that they did, but we will correct this. Well, in the By-Product Material Regulation, the revision of it recently, we made two significant changes. One was to relax the controls over domestic distribution of about 65 byproduct materials, so that they could be possessed under general licenses and would not have to be submitted on individual applications for each material.

Secondly, we eliminated the control on foreign distribution of isotopes with the atomic Nos. 3 to 83, inclusive. This means that any domestic licensee possessing those isotopes may freely ship them under a general license, to countries other than the Iron Curtain countries without obtaining any specific authorizations from the Commission. This eliminates a considerable amount of administrative detail that was involved in the previous program.

Representative COLE. What is the significance of the numbers 3 to 83?

Mr. PRICE. It leaves out, I think, for handling on a specific case-to-case basis, tritium, and possibly polonium, an heavier items.

Dr. LIBBY. Heavy water is an atomic No. 1, and tritium, and then you go to the heavy elements of uranium and plutonium, and so on. Helium—and this applies to radioactive isotopes—I am sorry, but tritium is the main one in the lower end, and then plutonium and uranium and similar things on the upper end.

Representative COLE. It starts at 84.

Dr. LIBBY. Plutonium is 94, and uranium is 92.

Representative COLE. I asked about 83. I was curious to know why you picked 83.

Dr. LIBBY. Polonium was involved there.

Representative COLE. I can refer to the tables for that.

Mr. NORRIS. Is 83 not lead?

Dr. LIBBY. Lead is 82.

Representative COLE. Let us not speculate if we do not know, let us not clutter up the record with a lot of answers that are not authentic. Even though the person giving an answer is an expert.

Dr. LIBBY. Thank you, sir.

Mr. PRICE. The regulation containing standards for protection against irradiation, part 20, I think we discussed fully in the testimony earlier, so I will not say any more about that.

I will not go into that unless the committee has some further questioning.

The operators license regulation was issued to be effective the third of this month. This is the regulation, the so-called pilot's license regulation, under which licenses are required for individual persons who operate the consoles of the reactor facilities.

I might mention one problem here that in some ways is important. We had in connection with this regulation the problem of whether to impose security limitations in the sense of a loyalty test upon the operators of these facilities regardless of whether access to classified information was involved. Of course, in any case where the operator or any other employee of a licensee will have access to restricted data, he will have to be investigated and cleared in accordance with the clearance regulations.

Representative COLE. The law requires you to license all persons engaged in operating an atomic reactor?

Mr. PRICE. That is right.

Representative COLE. Who are your licensees for the *Nautilus?*

Mr. PRICE. They are exempt, sir. The *Nautilus* is not a licensed facility. The operator's license provision applies to operators of licensed facilities.

Representative COLE. My statement is not correct, that the Commission is required to license all persons who operate atomic reactors?

Mr. PRICE. I am sorry, it is not correct. It is atomic reactors that are required, themselves, to be licensed. It is licensed facilities.

Representative COLE. And the Commision is not required—or to change it—atomic reactors built and operated by any of the military departments are not required to have a license from the Commission?

Mr. PRICE. There will be, perhaps, an exception. In one of the naval appropriation bills there is a Navy research reactor that is being built under an appropriation act where Congress required that it be built under the licensing procedure, and so I suppose in that case, that is the exception that proves the rule. That is the case of a special Act of Congress. Under the Atomic Energy Act, military facilities are not subject or required to be licensed and the operators, therefore, would not have to be licensed. Similarly, Commission contractors, or the Commission-operated facilities like Hanford and Savannah River—those operators are not required to be licensed.

Representative COLE. If and when we have an atomic ship, or merchant ship, the operators of that reactor would have to be licensed by the Commission.

Mr. PRICE. I assume that under the act—perhaps I had better ask Mr. Mitchell—but assuming, as the law now stands, the owner of the ship would have a license for the facility, the operator would have a license, is that right?

Mr. MITCHELL. That is right.

Mr. PRICE. The point I was about to come to was that the Commission decided not to impose a test of loyalty as a condition of a license where the activity is unclassified.

The rules of practice are in a separate regulation which establishes the Commission's administrative procedures dealing with the issuance, amendment and transfer and the renewal of licenses, and procedures for imposing requirements by order for modification and suspension or revocation of licenses, and the rules for the conduct of formal hearings. This is the regulation that gives to licensees and applicants for licenses the due process that is required by the Adminstrative Procedures Act.

Coming now to the regulation for access to restricted data, I think that this program was discussed rather fully yesterday, and I will only mention briefly the criteria for issuing access permits. These criteria are stated in the regulation. In the case of applications for access to confidential restricted data, the company needs only to show a potential use for the information. In the case of secret, applications for information classified as secret, the company is required to identify specific categories of information that it requires and then demonstrate a need for that information in connection with its business, trade, or profession. The regulation provides that this need should be stated by describing its use either in specific research, design, planning, con-

struction, manufacturing, or operating projects or in studies or evaluations planned or underway or in work or services of this kind to be performed for others.

I might also mention that in the final issuance of this regulation, the Commission, as pointed out yesterday, has included the category of information relating to controlled thermonuclear projects. The Commission made a complete waiver of all rights to patents which might otherwise accrue to the Commission under secton 152 of the act insofar as those patents are developed by the holder of the permit on the basis of the classified information that he receives pursuant to the permit.

Representative COLE. In your discussion of the regulations, you point out that the law prohibits an applicant for a license to be a corporation which is owned by foreigners, and that the law is silent with respect to individual license.

Mr. PRICE. I believe I skipped over that in my oral presentation.

Representative COLE. I did see it in glancing down there. I commend you for interpreting that, or at least in the regulations to carry out the philosophy that was contained in that.

Mr. PRICE. We thought we ought to follow the policy for corporations and prohibit individual aliens from getting it.

Representative COLE. I can further say that that is the first instance which has been brought to my attention where the law needs to be changed. It was an oversight and unquestionably we meant what we said referring to corporations. We said they cannot run these reactors, and also we meant to include individual aliens. That is one place that the law was defective, but that was through oversight, and it should be changed.

Mr. PRICE. Mr. Chairman, that completes what I had to say in connection with the regulations. There is, in addition, here, a statement of the status of the various applications for licenses of all kinds that we have received since the new law went into effect. I believe all of this information has been published from time to time, and unless you care for a discussion of it, I would offer the balance of it for the record, and respond to any questions that you may have about these cases.

Representative COLE. Yesterday I raised some questions about the number of license applications. That is, applications for licenses, and the number issued, and you said later on in your statement you were going to discuss that. Is this the place where you are going to discuss that?

Mr. PRICE. This would be the place. The question we had then was, now many people had gotten access permits, and there were over 600 companies. And I believe you asked about the individuals. You asked how many people were involved.

Representative COLE. No matter what I asked yesterday, let me ask now, how many applications for facility licenses have been made?

Mr. PRICE. Fifteen.

Representative COLE. That is applications, and how many have been granted? Have 7 been granted?

Mr. PRICE. Well, I do not have the total on that.

Chairman ANDERSON. Suppose you read into the record a list of those granted.

Mr. PRICE. Can I run through this list of 15, and we can tell you which ones have been granted.

Consolidated Edison, application is pending; Commonwealth Edison Co., is pending; and the Power Reactor Development Co., that is the group formed by the Detroit Edison Co., is pending. There are three power reactor applications. On research reactors, the Armour Institute has a construction permit, and they have not yet completed their facility.

Battelle Memorial Institute has a construction permit. It is under construction. The Naval Research Laboratory——

Chairman ANDERSON. You mean it has been granted?

Mr. PRICE. Yes, sir, the construction permit has been granted.

The construction permit has been granted to the Naval Research Laboratory for the research reactor that we mentioned a while ago.

North Carolina State College has been issued a license.

Penn State University has been issued a license. That facility is operating.

The University of California, Los Angeles, application pending. University of Michigan has received a construction permit.

Applied Nucleonics Corp., that is pending. That application came in December 15.

AMF Atomics, New York, I think they submitted their application on January 10 of this year, and the application is pending.

Ford Motor Co. submitted its application on January 13 of this year, and that application is pending.

General Electric Co. submitted an application on January 10 of this year, and that application is pending.

Then there are some critical assembly facilities, Babcock & Wilcox has been issued a construction permit for a critical assembly facility.

Battelle Memorial Institute has been issued a construction permit for such a facility.

Fuel element fabrication plants—these will not be subject to facility licensing, but they will be subject to special nuclear material licensing. There are three applications pending: B & W, for a plant at Lynchburg, Va.; Metals & Controls, for a plant in Massachusetts; and Cook Electric Co. for a plant in Illinois.

Three operator's licenses have been issued, 13 are pending. And then all of these cases, these facility cases that I have mentioned, involve applications, of course, for special nuclear materials as well as for the facility licensing, and in addition we have received 15 applications for licenses to receive special nuclear material for various types of research work.

Source material during 1955, 1,874 licenses. Those are issued.

Representative COLE. Has anybody been keeping a tally so I can have an answer to my question? I started out to, and then something else happened.

Mr. FIELDS. I tabulated 6 construction permits as being issued, and 2 licenses, sir, on the facilities.

Mr. PRICE. That is 8, and that means 7 pending.

Representative COLE. 7 out of 15.

Mr. PRICE. 7 out of 15; yes.

Representative COLE. There were 19, were there not?

Mr. PRICE. On facilities, I think that there are 15.

Representative COLE. You said since January you have had 4.

Mr. PRICE. No; I meant since the licensing program went into effect it was 15.

Chairman ANDERSON. Your own words are here, "During 1955, 15 applications were received." Then down below it says, "In January of 1956, 4 additional were received," and Mr. Cole added 15 and 4 and he got 19.

Mr. PRICE. 19 is correct; I am sorry.

Representative COLE. 7 out of 19 are under way and have been granted.

Mr. PRICE. Yes, sir.

Representative COLE. Now, with respect to this type of license, can you give me an estimate of the length of time it takes to obtain a license? Is there anything to this complaint that we occasionally hear from industry or applicants that it takes so long to get anything done by the Commission?

Mr. PRICE. Sir, I don't know what the complaint is about licenses.

Representative COLE. Tell me how long it takes to get an application through.

Mr. PRICE. It would only take a matter of a few weeks, if the applicant had all of the information that we needed when he first comes in.

Representative COLE. What is a few weeks?

Mr. PRICE. Two or three, but this will not happen in any case that I can think of, because the applicant comes in with his application before he has developed his technical information. Then we wait for him to develop the technical information. We cannot move any faster than he can.

Chairman ANDERSON. Does that apply to the Commonwealth Edison one in Chicago? They had a firm bid of so many million dollars to build a plant, $45 million.

Mr. PRICE. And they do not have detailed designs yet and they still have some experiments to run that they plan to run, and we will be able to issue to them a construction permit almost any time. It will be highly conditional. So far as I know, they have no complaints at all, and they are moving along with their project. They will get a construction permit which will reserve on all of the detailed hazards questions, it will tell them substantially that their design concept looks all right, and that their site looks all right, and that is all.

Representative COLE. When an applicant presents all of the information needed to support the application, he will have an answer on it within a month?

Mr. PRICE. I would think so, sir. Give or take a little.

Chairman ANDERSON. I want to come back to your statement on this one, take Commonwealth Edison, you say that as soon as you are satisfied that the design concept looks all right, and so forth, that you can begin to process it. Now, that one has been engineered by a company that is a well-known American firm, at least.

Mr. PRICE. This is true, yes.

Chairman ANDERSON. And they have engaged Bechtel Engineering Co. out in California, who have some thousand or more engineers on their staff, to do the engineering, and it got far enough along so a company could bid, and I do not mean this unkindly, but who have you got that is so much more competent than Bechtel and General Electric that you can finally pass on this design complex?

Mr. PRICE. We do not propose to influence the design of these licensed facilities in any way. The Commonwealth people and their engineers and the GE people have been in touch with us to discuss the hazards problem that they have to meet. They have some experiments that they want to run. They do not yet have the answers to all of the hazards questions that our technical people, including our Advisory Committee on Reactor Safeguards, will want answers to. But this is not slowing down their project one bit.

Chairman Anderson. Is it safe to say that although they applied for a license on March 31, 1955, they are not yet really in shape to apply for a license?

Mr. PRICE. That is right, but we are ready to give them a conditional construction permit, and they know it.

Chairman ANDERSON. Some of us, or perhaps I should confine it to myself, recognize that the Russians had one plant in operation, and it was small, but it was a 5,000 kilowatt plant, and they say in a short time—I am not sure whether they said 2 years—they would have a plant of 100,000 kilowatts operating. Now, if these people do not get a chance to start building they will not have a 100,000-kilowatt plant in operation then.

Mr. PRICE. They are not ready to start building.

Chairman ANDERSON. Then the delay is solely the fault of Commonwealth and Consolidated and the power reactor company?

Mr. PRICE. I do not know whether there is a delay in their project or not, Senator, but I do not believe they would say that they are being held up by the fact that they have not yet received a construction permit. They have not said so to me or to any of my people that I know of.

Chairman ANDERSON. It would take several years to build once it gets underway.

Mr. PRICE. That is right, and their project has not advanced to the point where they are ready to start construction.

Chairman ANDERSON. I am mainly interested in these few large ones. Consolidated and Commonwealth and power reactor companies, they are important. Have you any time schedules as to when you think the license might be granted in these?

Mr. PRICE. I would guess that within the next month or two we wil be able to issue construction permits to Consolidated Edison and Comonwealth Edison. They will be conditional, and from time to time, as they develop their hazards evaluations, they will submit amendments to their applications which will be acted upon by our technical people, with the advice of the Advisory Committee on Reactor Safeguards, and those conditions will gradually get removed from the construction permit. The Detroit Edison application, I believe, came in at the end of the year, and I just do not know, I am not familiar enough with the status of it to comment on that.

Chairman ANDERSON. You do know that some fairly large plants are under construction in England.

Mr. PRICE. That is right.

Chairman ANDERSON. I am just hopeful that American enterprise might some day catch up with the British.

Mr. STRAUSS. They are Government plants, as you know.

Chairman ANDERSON. Then would it be the testimony that if we had gone around by the Government route, we would be able to build by now?

Mr. PRICE. I cannot answer that, but perhaps someone else could.

Mr. STRAUSS. We are already building by the Government route in Shippingport, and that is well advanced, and should come into operation in 1957.

Chairman ANDERSON. The only reason for the question is that a great many people are anxious about this program, and they have heard the announcement of plans, and word comes back that the license is not yet issued, and we want to establish that the people themselves are not ready for the license to be issued.

Mr. PRICE. They are ready to receive licenses, but the point is that the fact that they have not yet been issued the initial construction permit has not held them up at all because they are not ready to start construction.

Chairman ANDERSON. You say they cannot get the license because they have not submitted sufficient information. Once you get it, you told Congressman Cole, in a couple of weeks you would be able to clear it.

Mr. PRICE. I would hope so, but let us be sure that we understand that what these people are going to get under the law and the regulations are going to be construction permits to start out with. They will not mature into licenses until the plants are completed. So I do not believe the companies are being held up by any problems with us.

Chairman ANDERSON. I feel better with that assurance.

Mr. STRAUSS. I talk with the executives of these companies fairly frequently, and I have never had any complaint from them to this effect.

Chairman ANDERSON. I do not question that in the slightest, but I thought this was a good time to bring it out in the open, that this program is progressing.

Mr. STRAUSS. We are very appreciative of the fact it has been brought up.

Chairman ANDERSON. It is a private-enterprise program, and we have given them every chance in the world to develop this energy, and the impression prevailed in many quarters that it was just being held up and held up. Your testimony is it is moving ahead as rapidly as could be expected, and as rapidly as they seem desirable. If that is true, that would be everything we could ask, certainly.

Thank you very much, Mr. Price, and I appreciate your good information for us.

I think that we possibly had better move to this next field.

Mr. STRAUSS. We can make this very brief, Mr. Chairman. It is a very important field. This is Chapter V, on International Cooperation.

By reason of the fact it is one of the newest activities of the Commission, and one on which the Joint Committee is very currently informed, I would propose with your permission to simply high spot these 15 pages which I can do in at matter of minutes.

The program of international cooperation really began with the President's adress ot the General Assembly of the United Nations

on December 8, 1953. That was quickly followed by your committee, as a matter of fact even before any proposals had reached you from the Commission, in amending the law in order to make these proposals of the President effective.

The law was amended, and the Commission in effect started work on them in September of 1954.

The program has as its overall objective, to encourage and assist the peaceful applications of atomic energy all over the world.

It is first by raising the standards and conditions of living through the application of nuclear technology and thus eliminating the source of basic causes of unrest and frustration, and second by helping to create conditions of trust and good faith between the peoples of the world and their governments.

The major developments of the past year relate to bilateral agreements for cooperation, the proposed international agency, and the first international conference on the peaceful uses of atomic energy.

Chairman ANDERSON. Perhaps if you could, Mr. Chairman, elaborate a little on the International Atomic Energy Conference, we would like to have it. We are all somewhat familiar with it, and fortunately 12 of our members were in attendance at the conference.

Mr. STRAUSS. I intended to refer to that by making a bow to the members of the committee who had assisted in that enterprise. I will say that with respect to the agreements for cooperation perhaps it is only necessary to note that as of the date of this report there were 24 such agreements negotiated, and four others are in progress, and we have received inquiries from the countries listed at the top of page 3. These agreements as you know have to do in the main with the exchange of information, unclassified information, and the assistance with research reactors, and the provision of the necessary fuel for such reactors. There are three agreements, however, which are more extensive in their scope, as the committee is aware. Those are with the United Kingdom, Canada, and Belgium.

Representative COLE. Why do I have in my mind the figure that agreements have been made with 27 countries?

Mr. STRAUSS. There have been agreements, Mr. Cole, which have not yet become firm, not having lain before the committee for the statutory time. I am sorry that I do not have the precise figures in mind. I am sorry, the 24th figure omits the 3 to which I referred, United Kingdom, Canada, and Belgium, making a total of 27. However, there are others which are in the stage of completion as far as negotiations are concerned, but are not binding on the parties and will not be until they have been submitted here.

Representative COLE. When they are complete, they will make a total then including the United Kingdom, Canada, and so forth, of 31?

Mr. STRAUSS. I do not know the precise figure.

Chairman ANDERSON. The statement that you have is that 24 are pending 3 have been finished?

Mr. STRAUSS. For example, one was signed recently.

Chairman ANDERSON. Three were finished early, and then 24 were finished in 1955, and 4 are now more or less pending, so that all of those together make 31.

Mr. STRAUSS. One was signed with Korea after this document was typed, I think, and the numbers are being continually increased. I

will give you the precise number of countries, and the names of them, Mr. Cole, for the record.

The information referred to follows:

(*a*) A total of 24 unclassified agreements in the research field have been negotiated and the required legislative procedures have been completed. Of these 24, the following 23 are now in force:

Argentina	Italy	Portugal
Brazil	Japan	Spain
Chile	Korea	Sweden
China	Lebanon	Switzerland
Colombia	Netherlands	Turkey
Denmark	Pakistan	Uruguay
Greece	Peru	Venezuela
Israel	Philippines	

One such agreement with the Government of the Kingdom of Thailand is awaiting execution. Unclassified agreements with the Governments of Ireland, Austria, Yugoslavia, and the Federal Republic of Germany are being negotiated. In addition, interest in negotiating unclassified agreements has been expressed by Ceylon, Costa Rica, Guatemala, Haiti, and Iraq.

(*b*) Three classified agreements covering power technology and materials have been negotiated and are in force. Negotiations are now being completed with respect to classified agreements with the Governments of Australia, Switzerland, and the Netherlands.

(*c*) To summarize, 34 Agreements for Cooperation are in force awaiting execution, or under negotiation. Twenty-eight of these are for research and 6 for classified matters.

Representative COLE. Excuse me, I have to leave to go to the House, and I wanted to ask a question. Have you refused to sit down and talk with any foreign country in discussions looking toward an agreement for cooperation?

Mr. STRAUSS. No, sir; we have been accessible to all who would speak to us. We have not refused to sit down with anyone. There have been some negotiations that have been long on the way and have not materialized, but there has been no refusals to negotiate.

Representative COLE. Have you had any inquiries at all from Iron Curtain countries?

Mr. STRAUSS. I do not believe it is out of order for me to say that the answer to that is "No."

Representative COLE. If you should have such an inquiry, would the law prohibit you from entering into such an agreement?

Mr. STRAUSS. I do not believe it is a matter of the law.

Representative COLE. That is not my question. My question was: If you should have such an inquiry, would the law prohibit you from making such an agreement?

Mr. STRAUSS. I would like to refer that question to counsel before I answer.

Representative COLE. There is nothing in the law that says you can only deal with free countries. You can deal with any country you want to.

Mr. STRAUSS. These are questions which we would undoubtedly refer to the State Department.

Representative COLE. The question of policy is something else, but I am not talking about the policy. I am talking about the law.

Mr. STRAUSS. I don't believe the law recognized that any countries are unfriendly.

Representative COLE. The fact is that every country that has expressed an interest toward making an agreement for cooperation has

been heard, and discussed with, and in some cases the agreement has been consummated, and in other cases it is pending, and in no case has a country been rejected, and in no case has there been even an inkling of an inquiry expressing a slight degree of interest emanating from any of the Iron Curtain countries.

Mr. STRAUSS. Not so far as I know.

Representative COLE. Well, if any of those things had happened, you would know about it?

Mr. STRAUSS. I would think so.

Representative COLE. Thank you.

Mr. STRAUSS. You asked about the International Atomic Energy Agency. That has become the designation of the body which was proposed in the President's address to the General Assembly of the United Nations, and was so designated, I believe, in the resolutions of the United Nations last year which called upon the various member states to set this body up. The preliminary documents are in draft stage, and a meeting has been scheduled, I think for the 27th of this month here in Washington of a steering group or at any rate a smaller group of the 84 countries concerned. There are some 12 countries, I believe, which will meet here with the aim of seeing whether the language can be crystallized.

Chairman ANDERSON. You have good hopes for the success of this project, do you not?

Mr. STRAUSS. Yes, I have, sir. If the meeting in February, which will run into March, is successful, it will be preliminary to the presentation of its conclusions to a meeting in July of the 84 nations which is to be convened at that time.

Chairman ANDERSON. Are there any particular problems, big problems, in connection with the organization of this work?

Mr. STRAUSS. They are the problems of who votes, and there are the problems of inspection, and a multiplicity of lesser problems. Those I have just mentioned, I think, would be among the most difficult.

Chairman ANDERSON. I think the Baruch plan probably encountered opposition because of the insistence upon inspection. That is probably still a pretty serious problem.

Mr. STRAUSS. That is my observation.

Chairman ANDERSON. But we are moving in that direction?

Mr. STRAUSS. I think so. The international conference is too well known, and too fresh in our memories for any elaboration at this time, unless there were questions connected with it.

The next section of this part——

Representative PRICE. Before you go on with that, on this point that you have been talking about on the Atoms for Peace program, have you had any jurisdictional problem with any other Government agency on this? Is there any conflict as to who should run this program?

Mr. STRAUSS. No, it has been a very agreeable and frictionless cooperation.

Chairman ANDERSON. On the international conference, I was not meaning to cut you off completely from commenting on it, Mr. Chairman. We are trying to save time.

Mr. STRAUSS. I think comment would perhaps be superfluous.

Chairman ANDERSON. I for one feel it was a very worthwhile conference, and I think it was well attended, and even though as you said yesterday some of the results might have been smaller than we anticipated I think that it may take some time to find out whether the results were as large as we had hoped.

Mr. STRAUSS. The net is certainly a great gain for us and for the world and we have proposed a followup, another conference within 2 to 3 years, and that has been generally accepted. There is some question in the minds of the scientists who attended as to whether it would not be desirable to have a series of conferences rather than one very large one. The reason for that is that it was necessary to run this as a 3-ring circus, with conferences going on on several subjects simultaneously, which made it impossible for men whose interests bridged more than 1 field to attend. That question is still open as to how the next conference shall be conducted, whether it should be a very large one covering all of these facets, or whether there should be a number of smaller ones with a greater degree of specialization.

The books in which the papers will be permanently preserved are beginning to come off the press. I have seen one volume, and I believe there are several others that have since been completed, and they are an impressive memorial to the results of the conference.

The next part of this report, Mr. Chairman, deals with the participation of the United States industry in these programs. I believe that is interesting but not novel. We touch then on the sale of heavy water. Foreign sales are a total of 129 tons which have been approved by the Commission, and 50 tons to the United Kingdom, 21 tons to India, 11 to Australia, 10 to Italy, 30 to France, and 7 to Switzerland. We established a price which was announced simultaneously in Geneva and Washington last August, which was substantially below the world price, which we feel should contribute to the use of this material in research and development.

We have sent atomic energy libraries to 43 countries. As you know, we have a number of such libraries around the United States, and these gifts to foreign countries have been greatly appreciated. I think they have done a good deal to provide an assurance of the fact that our expressions of interest and good will even in advance of the negotiations of bilateral agreements are more than lip service.

Chairman ANDERSON. I think that I would be glad to insert a word, saying that I agree fully with the statement. I commend the Atomic Energy Commission for the distribution of these libraries. I think it is a very fine step.

Mr. STRAUSS. Thank you, sir.

We have given foreign countries assistance in the utilization of isotopes by training their people. As a matter of fact we have an extensive program for the training of foreign nationals in isotope use, and in radiation therapy procedures, and these schools have been set up at Oak Ridge and at the Argonne Laboratory. The courses are not long, and the turnover is as rapid as we can make them. This is due to the fact that we have not a lot of money or a lot of staff available for instruction. Some of these countries have a shortage, actually, of people qualified to enter the courses, and that has acted as a barrier to their more complete utilization of the facilities.

But they are expanding, and we have great hopes not only of being able to train more of these people, but of making friends of them after they are trained.

That, Mr. Chairman, is a summary of this program. There will be, in the course of the next months, undoubtedly, applications to the Commission for bilateral agreements which will permit the construction of power reactors overseas and the Commission looks very sympathetically on that. We are going to move into that field with a good deal of vigor. We feel that our supply of the necessary material is adequate to enable us to approach it with some expectation that we can make a reasonable impact on the demand. We are not yet ready to announce any figures.

Representative PRICE. I just noted with interest in the final paragraph of that section of the complete section there with regard to the foreign students, and I notice that you give them half of the course at the University of North Carolina, and the University of Pennsylvania, and then at Argonne. That is a very splendid idea. I am wondering what your long-range plans are for the Argonne institution?

Do you plan possibly sometime to give them the full training at our universities rather than to have the Argonne institution in operation?

Mr. STRAUSS. The reason for their going to Argonne, Mr. Price, is that at Pennsylvania State and at North Carolina, the only reactors are research reactors. Incidentally, they are the only two research reactors that are presently available at colleges. I might say parenthetically we hope that the availability of research facilities and training facilities of that sort in the academic world will be substantially expanded. The reason those people have to go to Argonne is because at the Argonne Laboratory there is the largest assemblage of other types of reactors. That is, material testing reactors, and experimental reactors of one sort or another that these people can see and work around. Therefore, it is where they can obtain a degree of technological training that is impossible at these two other universities. That is true at the present time, of course.

Chairman ANDERSON. Mr. Strauss, every day has its problems for us, as it does for you. We have a bill on the Senate floor in which I have some interest, and Mr. Cole and Mr. Durham have a bill on the House floor in which they have some interest. I had asked Mr. Norris, since he had made a pretty careful study of regulations, to conduct a little more cross-examining on that subject. I do not know how long Mr. Price will be able to remain. But I wondered if you would have strong objections to our going ahead even if Mr. Price and I both had to leave?

Mr. STRAUSS. We would be very happy, and we know Mr. Norris well, and we will be glad to be as responsive as we can.

Chairman ANDERSON. Would you mind a half hour on this?

Mr. STRAUSS. That is fine.

Chairman ANDERSON. I am only trying to get through other things.

Mr. STRAUSS. What time do you want us back?

Chairman ANDERSON. At 2 o'clock, or perhaps, quarter after 2 would be better.

Mr. STRAUSS. That might be easier to handle.

Chairman ANDERSON. I always opposed a committee turning over its functions to a member of the staff, and conducting what I regarded sometimes as bad types of examinations.

Mr. STRAUSS. We are quite pleased, and content to go ahead.

Chairman ANDERSON. We will not try it again, I assure you, and if you reach a point where you have any objections to the general nature of the questions which I am sure you will not, you recognize that you have a perfect right to reserve that until the committee members return?

I am asking Mr. Price to stay as long as he can.

Mr. NORRIS. First, I have a series of general points which I think might be applicable across the board, and I want to go through these at the outset with you. As a very minor point, I notice you have some papers which are to be filed with the Division of Civilian Application, and some papers which are just to be filed with the Commission. I am wondering if it would not be preferable generally to file them with the Secretary, who is responsible for the paperwork in the Commission. Have you thought about this problem?

Mr. PRICE. Mr. Norris, I think the way the Commission is organized and the way the paperwork is handled there would be nothing but extra delay in having papers in connection with licensing, filed with the secretariat. It would just impose a paper burden on the secretariat. We did deliberately decide to have applications for licenses come directly to the divisions that will have to handle them. If there are some places in the regulations where we use the word "Commission" in connection with filing papers without saying where, I think perhaps we ought to go back and see if we ought to spell it out.

Now, in connection with reports and that sort of thing, it is probably enough to tell them to file them with the Commission because they will get to the right place anyway. The main reason for specifying the division in the case of license applications was that we knew applicants would have to have personal dealings with that division and we wanted to let them know that is the place to come initially.

Mr. NORRIS. Have you any idea how many activities you are going to co-license at any place or for any licensee?

Mr. PRICE. I am sorry, I did not hear you.

Mr. NORRIS. Do you have any idea now, as to the number or type of activities which you are going to license together for either one location or one licensee?

Mr. PRICE. I do not know what you mean by location there.

Mr. NORRIS. One facility, for instance.

Mr. PRICE. So far as a licensee is concerned, under the statute as we understand it, and under the regulations, he can apply for all of the licenses he needs in connection with his plans in one application, and he can get one license covering all of the licenses that he needs. That is including facilities, special nuclear material, and byproduct material, and source material.

To take an example, the reactor cases will need licenses for all of those things.

Mr. NORRIS. Have you given any thought to the question of whether your regulations are so worded that they could file one application for several facilities at once?

Mr. PRICE. Well, I do not know that we have. The problem in that kind of a multiple filing as a practical matter does not exist with companies now in the early stages of development, but as far as we are concerned, we are not going to be sticky about whether the man puts his application on 1 piece of paper or 2.

Mr. NORRIS. That is good.

Mr. PRICE. If he wants to file for 3 different facilities, and 5 different licenses, at 4 different places in 1 single document, we will take it and handle it.

Mr. NORRIS. I am glad that you have decided on this kind of flexibility. In your handling of common carriers, as for instance in the exemption in your facility licenses, you exempt the transportation or possession of any utilization facility by a common or contract carrier. Is this done as an exemption, or a power of exemption from the licensing, or is this done under some other theory?

Mr. PRICE. Well, I would rather Mr. Mitchell would answer the question to the extent it is a legal question. The effect or purpose of it is to make it clear that the Railway Express Co. and the Post Office, and the various railroads do not have to get licenses in order to transport these materials. Now, so far as health and safety problems are concerned, they will be covered by the control the Commission has over the shipper and the receiver, and the control the Interstate Commerce Commission has over the shipment.

Mr. NORRIS. I am asking for the authority on which you seek to make this exemption, that is all.

Mr. PRICE. Mr. Mitchell could perhaps answer that.

Mr. MITCHELL. I think, Mr. Norris, the answer is that the carrier would be merely the agent of the licensee for this purpose and the licensee would be considered to have constructive possession while the particular material is in the hands of a carrier. This, it seems to me, is a practical construction which is justified under the statute.

Mr. NORRIS. From what language?

Mr. MITCHELL. I confined my particular language to carriers, Mr. Norris, but it seems to me that when we look at possession, this is a permissible construction.

Mr. NORRIS. I was hoping that you were going to tell me that this was an attempt to clarify the words "to transfer or receive in interstate commerce," because if you use it as an interpretation of those words, which were designed in order to get around the actual transportation in interstate commerce, it would have been proper.

Mr. MITCHELL. I am glad to have your suggestion, sir.

Mr. NORRIS. My point in asking was to see whether you thought that you had any power to exempt classes of facilities or special types of treatment of facilities from the licensing requirements in any other way.

Mr. MITCHELL. We had not looked on this as an exemption, Mr. Norris.

Mr. NORRIS. I notice in the standards for your licensing of facilities and for operators, that you tie your standards in many instances only to public health and safety, while in the act at the same time they are also connected to the common defense and security. I was wondering what was behind this.

Mr. PRICE. Well, we have imposed security requirements in the regulations at the points where we thought the interest of security

required that we do so, and that is in the handling of restricted data licensees will receive.

The Commission has discretion as to how much regulation it will impose with respect to the use of material, and the Commission has concluded so far that the other requirements with respect to licenses and the incentive that the licensee has to protect the material and criminal provisions dealing with diversion are suffiicent for us to rely on. We hope it works. We think that will give us protection for the strategic value of the material. We will watch it, and we have reserved authority in the regulations to deal with any cases by order if it becomes necessary. But basically, what we have said is that the security problem to licensed facilities and even materials is a classified information control problem. To the extent that materials or facilities by their design or operation involve or reveal restricted data, then, of course, the security rules with respect to the handling and control and dissemination of restricted data will apply.

Mr. NORRIS. Is it not a question beyond the restricted data question, because you now are dealing also with special nuclear material, which has been found by the Congress to be such that title must be retained in the United States?

Mr. PRICE. We retain title, and make the man keep records, and we inspect him.

Mr. NORRIS. But you do not hinge the right or the standard for getting an operator's license to the man's willingness to abide by those standards.

Mr. PRICE. The man that is operating, whether he is the operator at the panel board, or whether he is the company that owns the facility, is going to be subject to the security regulations with respect to information control.

Mr. NORRIS. You are jumping the track on me again, sir, I am afraid.

Mr. PRICE. I am sorry. You are talking about the individual operator?

Mr. NORRIS. Yes.

Mr. PRICE. We consider that the basic reason for putting that man under a license is to be sure that he knows how to operate or manipulate the panel board safely. We do not, and I believe it is a fact in our own program, require any security tests or loyalty tests for workers in private industry who do not have access to classified information, and we did not attempt to impose it here.

Mr. NORRIS. My point is that you had a standard for operating the reactors so as to preserve the special nuclear material, and this is not a standard by which your operator's license would be given or withheld.

Mr. PRICE. I am sorry, I do not understand your question, Mr. Norris.

Mr. NORRIS. If an operator can operate a facility so that it fails to operate safely or in a healthful manner, you can revoke his operator's license; can you not?

Mr. PRICE. We would have the power to.

Mr. NORRIS. But if he could operate it safely, in a healthful manner, and still operate it so that he louses up all of the special nuclear material, you would not revoke his operator's license?

Mr. PRICE. If he loused up the material? I do not know what you mean by "loused it up," but if you mean that he damaged it in such

a way that his employer could not thereafter use it, the employer would have to pay for the cleanup of the material and get some more in the place of it. Now, if you are talking about lousing it up in the sense of creating a hazard, we are looking at the safety problem.

Mr. NORRIS. I am beyond the hazard, and talking solely from the standpoint of the material.

Mr. PRICE. His employer is responsible to the Commission for the value of the material that this map loused up, and it will have to come back to the Commission cleaned up at his expense.

Mr. NORRIS. I notice that all of your regulations are contingent upon the licensee's abiding by all of the AEC rules and regulations.

Mr. PRICE. Applicable rules and regulations.

Mr. NORRIS. This means a licensee who fails to abide by a byproduct or radioactive isotope regulation will have all of his licenses for facilities canceled?

Mr. PRICE. I am not sure the cross sanction is correct, and I would have to ask Mr. Mitchell to answer it. What we mean is that if a licensee possesses special nuclear material, he will have to comply with all of the rules applicable to that, the same as byproduct material. Whether, as worded, the license regulation means a violation of byproduct material rule would subject the man to the cancellation of a facility license, I would have to ask Mr. Mitchell to answer that.

Mr. MITCHELL. I think this would depend upon whether the other license applied also to the same activities. The fact that the same individual happened to have two licenses would not give rise to that.

Mr. NORRIS. But the regulations are so worded that in order to keep a license under one of them, he must abide by all Commission rules and regulations.

Mr. MITCHELL. It says "applicable," and you have to take this in a commonsense judgment viewpoint.

Mr. NORRIS. On the facilities regulation, I notice the Commission has not made any finding as required by the sections on definitions. Is there any reason why this has not been done?

Mr. PRICE. I beg your pardon. Are you talking about finding as to what facilities need to be regulated?

Mr. NORRIS. Yes, sir.

Mr. PRICE. Well, the Commission made the finding and the publication of the regulation, I would think, satisfies all of the procedural requirements. But I would have to ask Mr. Mitchell.

Mr. MITCHELL. I think that that is right.

Mr. NORRIS. In other places, throughout the regulations where there is a finding required by the act, there is a special note that the Commission has made this finding. This was just an administrative oversight, then, on these?

Mr. PRICE. I think we considered when we published the regulation, and they were adopted by the Commission, determining what facilities would be subject to the regulation, that that was putting the world on notice that the Commission had made the finding.

Mr. NORRIS. But had the Commission specifically made the finding in its minutes?

Mr. PRICE. Yes, sir.

Mr. NORRIS. I notice in your definition of facilities you defined a nuclear reactor in such a way that you only apply this to fission

processes, although the act gave you the power to include fusion processes, too.

Mr. PRICE. The reason for that was that at the time the regulation was adopted, or rather the proposed rule was adopted, the existence of the Sherwood project was classified. Since we knew that as a practical problem we had no American industry ready to go into the field, we deliberately left it out. Now that the existence of the project has been declassified, there is no reason why we should not add "fusion" to that definition. As a practical matter, it does not make any difference for the time being, because we are not going to get any applications for projects real soon.

Mr. NORRIS. Except as a practical matter, too, the prohibitions are tied to the same definitions as your regulatory powers are tied to.

Mr. PRICE. I am not clear on this. The prohibitions on what?

Mr. NORRIS. The prohibitions contained in section 101, with respect to facilities, are tied to the same regulations and the same definitions as your regulatory powers.

Mr. PRICE. That is right, but all I am saying is that to prohibit someone from transferring thermonuclear facilities at this point would not accomplish anything because there are none to be transferred in private industry.

Mr. NORRIS. In your regulations on the facilities, you have an indefinite term to be negotiated out apparently in each license.

Mr. PRICE. I am not sure I agree with the words "negotiated out." We have taken the guidance the statute gave us, and it says that in the case of a 103 license the maximum is 40 years. As far as we can see, there is no particular reason for not issuing a facility license for the period the applicant requests. That is, if it bears any reasonable relation to what might be the useful life of the plant. So I think that our attitude is pretty relaxed on the term of the license. We are pretty apt to go along up to 40 years with the request of the applicant.

Mr. NORRIS. This is a good clarification of your section 50.51, although it had bothered me a little.

Could you tell, for the record, why you went to class 103 and class 104 licenses instead of going to commercial, developmental, and medical licenses?

Mr. PRICE. All of those words are in the regulations, but for convenience in characterizing the classes it seemed to us simpler to give them a short title. That is corresponding to the statutory sections.

Mr. NORRIS. My purpose in asking this is that it is only the demonstration reactors regulations which are tied in any way to the regulations for 103, and you are lumping all of the regulations in 104 together, and it will lead to confusion.

Mr. PRICE. I do not believe the regulations tie in any way the medical reactors under 104 (a) or the research reactors under 104 (c), to section 103.

Mr. NORRIS. No, except insofar as you use the same things all of the way through, where 104 (b) is tied to 103.

You have listed in your work different types of reactors for which licenses have been applied, that is the boiling water reactor and the breeder reactor. Have you given any thought to having separate regulations for parts of the regulatory processes for each of these types of reactors?

Mr. PRICE. We thought about it, and for the time being rejected it primarily for this reason: We are unable to develop any definitive standards for hazards evaluation in detail for any of these reactors yet because the technology has not developed to the point where we know the hazards answers on all of these types of reactors. We figure that in this developmental period the hazards evaluation business, which is really the chief licensing problem, is going to be handled, or will have to be handled pretty much on a case-by-case basis under some general standards which, of course, we do have. We really would not add anything to the value of the regulations or the procedure except length if we tried to spell out something separate for each type at the present time.

Mr. NORRIS. Do you anticipate doing it in the future?

Mr. PRICE. As the reactors are developed and prove out, and we begin to get standards in the sense of people wanting to build copies of them, then we will be at the point where we ought to consider doing that. Then we will have some definitive answers on the major hazards problems, and we will be able to spell out for each type of reactor what the basic hazards protection has to be. I do not believe it will be helpful to try to do it now.

Mr. NORRIS. I would think that if you waited until you were reaching a carbon-copy stage you would be waiting until you were almost reaching a stage when reactors might be found to be of practical value.

Mr. PRICE. That could very well be.

Mr. NORRIS. And this is not the way that I recall the section 104 regulation was hoped to be drawn. In the operator's license, I notice you try to get supervisors in, while the drafting of the act excluded supervisors.

Mr. PRICE. We only attempted to cover supervisors to the extent that they will in fact manipulate the controls.

Mr. NORRIS. That is not quite the definition in the regulations. It is—

> An individual is not deemed to manipulate a control within the meaning of this definition if he manipulates the control only under the direction and in the presence of a licensed operator.

Mr. PRICE. All right, surely there will be the case of a supervisor who will be standing in the presence of a student and will be saying, "Push this button," and that supervisor, as far as we are concerned, is the man that is manipulating the control and he will have to be licensed. But normally, he will be physically using his own hand to do that on occasions anyway, so as a practical matter he is going to need a license.

Mr. NORRIS. That is different. But let us omit the student. That is a special problem. With this definition you would include the supervisor anyway, even though he would not ever, himself, manipulate the controls.

Mr. PRICE. Not unless he either, in fact, manipulated them or went down to the panel board and directly instructed them.

It may require further refinement as we get some practical experience.

Mr. NORRIS. Yes, but does this not attempt to bring in the supervisor and require amendment to the law?

Mr. PRICE. Only if he does the things in terms of manipulating the controls that we have specified. It will require some supervisors to get licenses, and Dr. Beck down at North Carolina State has applied for a license. He goes in that place and manipulates the controls.

Mr. NORRIS. I have no objection with that one.

Mr. PRICE. That is the way we will figure it will happen in the case of most supervisors.

Mr. NORRIS. What bothers me is the extent to which you have extended the definition of "operator," as drafted in the act.

Mr. PRICE. I think we thought we narrowed it to the extent that we had flexibility and authority to do it.

Mr. NORRIS. I have heard that there is a possible problem in the operation of future reactors which may be designed to be controlled by computers, and that this definition in the act would require the persons who are operating the computers to get licenses. Have you come across this problem?

Mr. PRICE. No, sir; but when that time comes, we will have to take another look at it.

Mr. NORRIS. In the isotopes regulation, I notice that on page 20 of the text of your statement, you have under consideration a number of further changes in the byproduct material regulations. These relate principally to the following matters, and then:

(c) The extent to which AEC, in reviewing applications by doctors to use byproduct material in medical diagnosis and therapy should consider the doctor's clinical isotope experience and other qualifications to decide upon the need for such use of byproduct material and the proposed course of isotope administration.

Mr. PRICE. This is not as big a problem as that sounds, but there has been some confusion and I must say some disagreement among the medical people on the point of the extent to which we should examine into the experience of a doctor before issuing a license to use isotopes for medical treatment and diagnosis. The present practice of looking at the health and safety problem fairly completed is based on the almost uniform and continuous recommendations that we have received from our isotopes advisory committee, and the medical members of that committee. There have been instances where competent medical people have said that this smacks of regulating the practice of medicine. All we are saying here is that we are going to give these people a chance to have their say and I do not know how we will come out.

Mr. NORRIS. The reason I jumped at this was because I had heard at one place a statement that the Commission might consider passing on the doctors who would be administering this and I wanted to have the record set straight on that.

On your regulation 57 (a) (3), under your authority——

Mr. PRICE. Would this be a good time to plead the statute of limitations?

Mr. NORRIS. Let me get this atomic energy statute in here first. The authority for your reports under this 57 (a) regulation is said to stem from 161 (p) of the act.

Mr. PRICE. I would have to ask Mr. Mitchell; I believe that is right. The regulation recites that section.

Mr. NORRIS. It does, but this does not recite 57 (a) (3).

Mr. MITCHELL. May I answer this, Mr. Norris? I think that our references were to section 161 generally, and specifically to 161 (p);

161 (p), of course, gives the Commission authority to require by rule, or regulation, or order such reports with respect to, and to provide for, such inspection as may be necessary to effectuate the purposes of the act.

Mr. NORRIS. What section is that?

Mr. MITCHELL. 161 (p). I abridged it as I read it.

Mr. NORRIS. Let us read it verbatim.

Mr. MITCHELL. Very well, sir.

In the performance of its functions the Commission is authorized to require by rule, regulation, or order, such reports, and the keeping of such records with respect to, and to provide for such inspections of, activities, and studies of types specified in section 31 and of activities under licenses issued pursuant to sections 53, 63, 81, 103, and 104, as may be necessary to effectuate the purposes of this act, including section 105.

Mr. NORRIS. I believe 57 (a) (3) is conspicuous by its absence.

Mr. MITCHELL. I do not read this section to be limited, Mr. Norris, to the sections enumerated here. It says "studies of types specified in section 31, and activities licensed."

Mr. NORRIS. I think that that is all I have.

The meeting will adjourn until 2:15 o'clock.

(Whereupon, at 12:35 p. m., a recess was taken until 2:15 p. m., of this same day.)

AFTERNOON SESSION

Representative DURHAM (presiding). The committee will come to order.

I believe we had reached the point this morning up to part VI, is that correct?

Mr. STRAUSS. That is correct, Mr. Chairman. Mr. Jesse Johnson, the Director of the Division of Raw Materials, of the Commission, is here at the table, prepared to highlight that section, and go into as much detail as the committee desires.

Representative DURHAM. All right, Mr. Johnson, you may proceed.

STATEMENT OF JESSE JOHNSON, DIRECTOR, DIVISION OF RAW MATERIALS, ATOMIC ENERGY COMMISSION

Mr. JOHNSON. I have a rather brief report. I think possibly it would take only about 10 minutes to read, and it might take as long to highlight. May I read it, then?

Representative DURHAM. You may proceed.

Mr. JOHNSON. In 1955, United States uranium milling capacity was about double that of 1954. With the new mills now under construction and planned, milling capacity again may double by the end of 1957. Domestic ore production in 1955 increased 45 percent over 1954, and was considerably greater than the total tonnage milled, although ore production and milling rates were about in balance by the end of the year. In 1956, however, ore production may increase faster than new mill facilities can be added, so that the total quantity in stockpile may not be reduced until 1957.

Domestic private exploration was extremely active. The major new discovery was in the Ambrosia Lake area, McKinley County, N. Mex., where several private companies have been drilling since midsummer. Preliminary information already indicates several million

tons of ore. Total reserves may prove to be much larger. No outcrops were found in the immediate area and exploration is being conducted on the basis of geological structure. The ore deposits are found at depths of from 300 to 900 feet.

Other important additions to known ore reserves were the result of further development in the Laguna Indian Reservation, N. Mex., in the Big Indian Wash-Lisbon Valley district, Utah, and in the older districts of the Colorado Plateau. In the relatively new areas of activity—Texas, Wyoming, and Washington—exploration indicates that ore reserves may be sufficient to support milling operations.

Uraniferous lignites in North and South Dakota and Montana, discovered about a year ago, may become a significant source of uranium provided the technical and economic problems of processing can be solved.

In the foreign field, the outstanding developments were in the Blind River district, Ontario, just across the United States-Canadian border. Here activity concentrated on opening mines, constructing mills and proving up a field discovered in 1953. One mill already is in operation. This area should be mining and milling about 7,000 tons a day by the end of 1956 and by about 1958 there may be 8 or 10 mills treating a total of 25,000 to 30,000 tons of ore per day. Ore reserves in excess of 100 million tons seems reasonably assured and the extent of the field has not been fully determined.

Elsewhere in Canada uranium development also was active. The large Gunnar mill of Gunnar Mines, Ltd., on Lake Athabaska was completed and put into operation. The Eldorado Mining & Refining Co.'s operations at Beaverlodge Lake are being expanded. A mill is to be constructed in the Bancroft area, Ontario.

The south African uranium program, which was initiated in 1950, should be approaching full production about the end of 1956. This program was one of mill construction rather than ore development. The current program does not indicate the maximum uranium production that south Africa can achieve. Expansion of existing gold mines and the opening up of new mines will offer opportunity for additional uranium production from gold-ore tailings. There also are vast quantities of lower grade tailings not being utilized in the present program.

In Australia 2 new areas are being developed, 1 in the Alligator River district of the Northern Territory and the other in the Mount Isa district, Queensland. The latter, at least, may support a substantial uranium milling operation. The Belgian Congo continues to be an important contributor to the total uranium supply. The uranium mine in Portugal is operating at capacity and the Portuguese Government has embarked upon an extensive exploration and development program.

For the past several years we have been cooperating with foreign countries in establishing exploration programs and in conducting surveys for radioactive minerals. As a result of the great interest in atomic development stimulated by the Geneva Conference, we now have a number of additional requests for cooperation in the field of raw materials.

The Commission's domestic exploration organization now has a major job in following the farflung private prospecting activities and

in appraising the production possibilities. Because of the nature of the Commission's domestic uranium program, we must know where and in what quantity new production will be offered for sale. Another important phase of Government exploration is the development of geological information to assist private prospecting and the evaluation of the Nation's uranium resources and potential resources. An important part of the Commission's exploration program is carried on by the United States Geological Survey and the Survey is now concentrating on long range studies.

In the early period of the domestic uranium program private industry did little exploration drilling except in the vicinity of uranium outcrops. Because of the urgent need for domestic production, the Commission undertook a major drilling program on public lands showing no outcrops but considered geologically favorable for uranium. Before drilling, these lands were withdrawn from entry under the mining laws.

This exploration program not only developed important uranium deposits, but pointed the way to private industry. Private industry has now taken over much of the work that originally only the Commission was prepared to do. In 1955 private drilling probably exceeded 4 million feet. Consequently it is anticipated that no additional public lands will be withdrawn for AEC exploration, and that lands now under withdrawal orders will be restored to the public domain or leased for uranium mining, depending upon the results of Government drilling. All AEC development drilling is expected to terminate early this year with the completion of drilling on lands already partially explored. A small program of Government drilling to obtain geologic information may continue beyond that time.

On December 21, 1955, the Commission announced that a system of competitive bidding will be instituted for leasing uranium deposits developed by AEC on withdrawn lands and certain other areas under AEC control. Leases will be awarded to the acceptable bidder offering the highest cash bonus by sealed bid. The royalty rate, work requirements, and other conditions will be stated in the invitation to bid. Copies of the press release announcing the bidding procedure already have been furnished this committee and a copy also is attached to this report.

Representative COLE. May I interrupt to inquire—in scanning through your earlier statement, Mr. Johnson, my attention was focused on the new areas in Australia. May I inquire the location of the new field in the Northern Territory? Is it anywhere near the Darwin field?

Mr. JOHNSON. It is about 80 miles west of the Rum Jungle field. That is the Alligator River field in the Northern Territory. The Mount Isa district, I think, is approximately 800 miles west of the Rum Jungle area in Queensland. That is the most important of the two.

Representative COLE. Is the Rum Jungle in the Darwin area?

Mr. JOHNSON. Yes.

Representative COLE. Both of these new fields are then in the same general area of Australia?

Mr. JOHNSON. The Alligator River is in the same general area, and the other field, Mount Isa, has access from the west coast, not through Darwin.

Representative COLE. From the west coast or the east coast?

Mr. JOHNSON. I am sorry. My directions are wrong. It is the east coast.

Representative COLE. My reason for inquiring about the general proximity of the areas is to learn to what extent they will be able to use common facilities, port facilities, storage, refining, if that is the correct word, or will it be necessary to have duplicate facilities all the way through?

Mr. JOHNSON. The Alligator River deposit will receive its materials by transport through the port of Darwin. Possibly a new mill will be built in the area by private industry, although development has not progressed far enough to determine whether there are sufficient ores. In the Mount Isa district, the deposit is tributary to the east coast. It will require a separate mill, and I believe one of the large private companies is planning to build such a mill.

Representative COLE. Are there in existence transportation facilities in the Mount Isa district, for instance, rail?

Mr. JOHNSON. Within about 40 miles of the property—I am not sure as to the distance—is a large copper operation, the Mount Isa Copper & Lead operation, in which the American Smelting & Refining has a substantial interest.

Representative COLE. Will that railroad be extended into the Mount Isa uranium district or will overland motor transportation be used?

Mr. JOHNSON. I would think that the transport from railhead to the uranium mine will be by motor transport.

Representative COLE. What is the quality of the mineral in these two areas?

Mr. JOHNSON. Comparable to the Rum Jungle or the Colorado Plateau. Apparently the world over now, except for the low grade ores of south Africa, ores are of the same general grade.

Representative COLE. Not generally of the grade that is found in the Congo, or do you include the Congo when you say south Africa?

Mr. JOHNSON. The Congo is now treating large tonnages of ore in the mill and treating lower grade ore than it treated originally. It is treating tailings and stockpiles of lower grade material that were discarded in previous operations, as well as the high-grade ore coming from the mine.

Representative COLE. Is it security information as to the degree of richness of the Australian ore?

Mr. JOHNSON. No. The inforamtion has been published. The information on the Canadian ore has been published. In general the grade of the ore ranges from two-tenths of 1 percent to four-tenths of 1 percent. In the Blind River area of Canada, there has been a great deal of information published on the grade there. That ore averages about one-tenth of 1 percent or 2 pounds of uranium oxide per tone. The Blind River deposits are geologically very similar to the south African deposits. The Big Reef deposits are very extensive, the diffence being that there is very little gold, maybe 20 to 50 cents' worth of gold per ton of ore in the Blind River area, whereas in south Africa the reefs have been mined as gold ores.

Representative COLE. Thank you very much.

Representative DURHAM. Mr. Johnson, we have a rollcall that we are going to have to go to, and we will have to suspend for about 15 or 20 minutes. Under the circumstances there is nothing else we can

do. In the Senate they are having the same trouble this afternoon.

Mr. JOHNSON. I can finish this in just a few minutes, if that is convenient.

Representative DURHAM. We can wait a few minutes. We can catch it on the last call.

Mr. JOHNSON. Shall I continue?

Representative DURHAM. Yes.

Mr. JOHNSON. In addition to reviewing the developments of the past year, it might be well to discuss the present status of the uranium-production program and some of its problems.

Defense programs have led to the development of a privately owned and operated industry of major economic importance. Before long it will be a $500 million-a-year business, with the domestic share about $200 million. The United States and Canada each will soon be producing more uranium than was in prospect for the entire free world only a few years ago. Already the economy of important areas in some of our Western States is heavily dependent upon uranium mining, milling, and related activities.

Representative COLE. Mr. Chairman, in view of the fact that we will have to suspend here very soon, I wonder if you would mind if I interrupt to solicit the opinion of the Commission on one of the recommendations of the McKinney panel, to the effect that the raw materials procurement programs of the Commission be directed toward the day when uranium mining will be free and competitive, without any subsidy or Government guaranty. It is conceivable that this is of such a nature and magnitude that the Commission would want to deliberate rather extensively on it. If so, I hope you would say so.

Mr. STRAUSS. The difficulty with answering it is that we have not yet completed an analysis and study of the McKinney panel report, and therefore I could not give you a Commission opinion on it. But we would like to be able to at some quite early date appear before the Joint Committee and discuss the recommendations of the McKinney panel in detail.

Representative COLE. Very well. Thank you.

Mr. JOHNSON. Probably no mineral-production program dependent upon new discoveries has grown so rapidly. Only a few years ago a supply of uranium for a limited defense program posed grave problems, and even some eminent scientists questioned whether sufficient uranium could be obtained to justify an important atomic-power development.

Ordinarily industry is responsible for planning future production. The uranium industry, however, has had to look to the Government. The Government has been the sole buyer of its products and will continue to provide the only important market until atomic power is firmly established on a commercial basis.

It would be desirable for industry to make its own studies of the future supply and demand and to plan its operations so as to assure that the supply will be adequate to meet future requirements. This has not been possible in the past, and for some time to come there may be limitations upon the information that can be made available to industry.

Military requirements no doubt will continue to be classified. Moreover, it is difficult to make long-range forecasts of these requirements. Weapons development may bring about changes in the need for ura-

nium, and the use of atomic powerplants for naval vessels, airplanes, and military land installations also will have an important bearing on future military needs.

The power industry and the manufacturers of equipment are now actively developing atomic power. As development work by the Commission and the industry proceeds, more reliable information will become available for forecasting the future commercial market for uranium. At the present stage of development, however, forecasting long-range requirements for civilian power is also difficult. Estimates have been made, but they vary greatly because of differing assumptions regarding such factors as reactor types, reactor economics, and the estimated rate of power growth.

Declassification of uranium-production data is one step which would assist uranium companies in planning for the future. This would give industry and the public facts upon which to form independent conclusions, and should tend to curb speculative excesses. Studies of present and potential uranium production and resources would benefit both the uranium and power industries.

Uranium-production figures have had security significance as a measure of our atomic-weapons program. Today, however, we are producing uranium for both the military program and the increasing civilian program. Furthermore, our uranium program has changed so that production now comes from many dispersed mining operations. Therefore, the Commission has under study the need for maintaining classification of uranium-production statistics.

Information on processes for extracting uranium from ores and uranium bearing materials already has been declassified. This should result in broader interest in uranium metallurgy and in more private contributions to the development of improved processes. Also, some of the uranium processes developed by the Commission may have application to the recovery of other metals.

One of the most important problems in the field of raw materials relates to domestic uranium procurement after March 31, 1962, the expiration date of the present guaranteed minimum price schedule. In the past we have attempted to obtain maximum production as rapidly as possible. By 1962 our objective may be to maintain production at some general level rather than to expand it, and at the same time encourage prospecting and exploration so as to develop ore reserves to assure a continuing domestic supply of uranium.

The Commission recognizes that there must be assurance of a continuing market over a reasonable period of time if a high level of exploration and development is to be maintained. Continued exploration and development are particularly important for the future of domestic production. Unlike the Canadian and South African mines, which have en estimated life of from 20 to 40 years, our mines can be exhausted in a relatively few years. As long as the Government is the only buyer of substantial quantities of uranium, a guaranteed price for a considerable period of time is needed to encourage prospecting and development.

Representative COLE. Why is it that our mines are shorter lived than the African?

Mr. JOHNSON. The nature of the deposits that have been found in this country. When we started out, we were dealing with deposits of only a few thousand tons with a 20 or 30 thousand ton deposit being

a large one. Now, however, we do have a number of deposits that are in excess of 100,000 tons, and we have 1 deposit that is measured in terms of millions of tons, and the new area in the Ambrosia Lake, which may be a series of deposits, contains some millions of tons.

However, the production rate has been stimulated by the type of program we have that has encouraged the owners of the deposits to try to mine their deposits out within the period of the guaranteed price schedule by 1962. If there should be no further development and exploration, and we should live off the ore reserves we have developed today, I think we would have very meager known ore reserves by 1962.

Representative COLE. That is, if we should live off our continental reserves.

Mr. JOHNSON. Yes, sir. If there should be no further exploration and development.

Representative COLE. Then I judge it is as a result of a combination of factors, one being the size of the deposits in American mines, and the other being the impetus that is caused by the guaranteed ore program to get the ore out as quickly as possible that results in the short life of our mines.

Mr. JOHNSON. Yes. The uranium deposits of the United States are in sedimentary beds. You might compare the domestic uranium industry with the oil industry. It is necessary to do active exploration in order to maintain reserves. We don't have these deposits like this in South Africa, where even under a crash program it would be impossible to mine them out in a short time.

Representative DURHAM. What is the characteristic of ores? The differential in ore strength, purity, and so on is characteristic in all the ores?

Mr. JOHNSON. Yes.

Representative DURHAM. In some areas of the world it is a much better ore and in some areas it is poor ore, and some is near the top of the earth, and some is deep?

Mr. JOHNSON. Yes, that is correct.

Representative DURHAM. But the biggest deposits have been found, have they not, at greater depths than we are mining in this country?

Mr. JOHNSON. Certain types of deposits of a vein type or even the bedded type of South Africa extend for long distances and to great depths. That is not true as far as exploration has gone in this country, although we now have some very large deposits.

Representative DURHAM. Proceed with your report please, Mr. Johnson.

Mr. JOHNSON. Otherwise, mining companies will concentrate on mining out known reserves. Only a few large companies are willing to tie up capital on the possibility of a future market. The individual miner and the small company must have a current market.

An active and healthy domestic uranium mining industry is important to the development of atomic power. The mere prospect of a uranium supply would hardly be sufficient to justify the large capital investment required for atomic powerplants. Furthermore, our uranium procurement program should be designed to prevent "boom and bust" operations, but to permit a gradual and orderly

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transition from a government-controlled to a commercial uranium market.

In summary, our principal problems relate largely to maintaining a healthy uranium industry, providing for the gradual transition from a government-controlled to a commercial uranium market, and placing industry in position to do long range planning instead of being dependent upon government announcements.

We see no problem in meeting the uranium requirements of the present military and power programs. We also believe that adequate supplies of nuclear fuel will be available to justify the present intensive effort to make nuclear energy a major source of industrial power.

Representative DURHAM. Mr. Johnson, we are getting pretty close to 1962. What is being done at the present time? Are plans being made along the lines that you suggest here, that we get this into private enterprise production and control operation?

Mr. JOHNSON. The staff has been working for the past several years as a matter of fact, but intensively over the last year or more, in studying various methods of handling our domestic uranium program and various suggestions as to what might be done after 1962. Of course the basic requirement for uranium is the military demand and it is difficult to forecast what military requirements might be 6 to 10 years ahead. That is one of the problems in arriving at an early decision as to the type of program, if any, that should be carried out after 1962.

Representative DURHAM. It makes it almost necessary that we stockpile uranium from a military standpoint and as a safety and security measure. Has there been any thought given to going into a stockpiling program at the end of 1962, that is, somewhat like we do the strategic and critical materials at the present time?

Mr. JOHNSON. I assume that will be a matter that will be discussed by the Commission in considering any program that might be carried on after 1962, provided there might not be a continued military requirement of substantial size.

Representative DURHAM. At the present time Canada has offered its ore in the public market?

Mr. JOHNSON. No, sir. All of the Canadian uranium that is being produced today is being sold to the United States, subject only to a reservation of the uranium that is required for Canada's own program.

Representative DURHAM. We are buying it all?

Mr. JOHNSON. Yes, sir.

Representative DURHAM. There was an article in some magazine which intimated, at least, that they were thinking of going into the commercial market.

Mr. JOHNSON. I think the Canadian producers who might not be ready to market their uranium at this time, and also the others, are considering what they are going to do in case there is no market to the United States. That is a question that I think all uranium producers are concerned about.

Representative DURHAM. Is there any demand now from the other countries that are signing these agreements for ore? Are they trying to purchase ore?

Mr. JOHNSON. I don't believe that there have been any discussions in connection with the bilateral agreements. I am not familiar with that. I do know, however, that there are European countries either

shopping around or interested in getting information as to the availability of uranium from other countries.

Representative DURHAM. Naturally, I think they are going to do that because if they get into the building of reactors, they will need it.

Mr. JOHNSON. I say some of them are already shopping around. Whether they are in a position or willing to contract at this time, I don't know.

Representative DURHAM. I think in 1962, we are going to have to look at this whole program very carefully. We have to do it before then, in my opinion, because of the strategic nature of the ore from a military standpoint. I think we are going to have to think somewhat about the price of the ore, and as to whether or not we are going up or down. It may become highly competitive.

I don't know whether you care to answer this or whether you should or not, but at the present time our stockpile of ore is sufficient for all the neeeds that we have as far as you can see for how long? Do you want to answer that?

Mr. JOHNSON. My understanding is that all the production we are receiving is going into the military weapons stockpile except for the material that is used in connection with the research and development projects.

Representative DURHAM. Then there is no large surplus of ore at the present time.

Mr. JOHNSON. That is correct.

Representative DURHAM. Mr. Cole, do you have any questions on this?

Representative COLE. Only to inquire if reaching your conclusion that you see no problem in meeting the uranium requirements in the future to meet our military and peacetime needs, do you take into consideration the increasing demands which inevitably will develop for these same materials from foreign countries?

Mr. JOHNSON. I probably was a bit too inclusive, but indicated present military and civilian programs and as far as we can see ahead would be about 10 years. How requirements will develop after that it is difficult to forecast. Certainly I would say that any foreseeable requirements based upon what I have heard about the civilian program within the next 10 years could be met from production that we now see. The production can be expanded considerably beyond that for which we have present plans, if necessary.

Representative COLE. Is there any indication that our present foreign sources will be cut off within the next 10 years? I did not express that very well.

Are there any pressures developing from those countries from which we now obtain raw materials to curtail or eliminate our procurement?

Mr. JOHNSON. May I answer in this way, Mr. Cole: We would have no trouble, in my opinion, in contracting for all of the uranium now being produced in the foreign countries with which we have arrangements for a period of 10 years if we so desired.

Of course, the South African production and the Congo production and also that from Australia is contracted by the Combined Development Agency, a joint United States-United Kingdom procurement agency, and the United Kingdom has an interest in that production.

Representative COLE. What is the life of those contracts?

Mr. JOHNSON. The South African contracts with the individual mines run for a period of 10 years and the first of the mines will complete the 10-year period about 1963. Mines will drop out from a contractual commitment in 1963, 1964, 1965, and finally at the end of 1966.

Representative COLE. How about the Congo?

Mr. JOHNSON. The Congo arrangement, I think, is expressed in the bilateral agreement in which we have a firm commitment through 1960, and there would be further discussions at that time.

Representative DURHAM. At the present time, Mr. Johnson, this has been a program that we have put all our effort behind; it is a good one. It has been an excellent job. It is one of the finest I have seen done since I have been connected with Government. If we could have done this in some of the other strategic and critical metals we would have been far better off in the last world war.

At the present time are you maintaining the same pressure on the exploration and the obtaining of ore as you have for the past few years, or are you at the present time kind of letting it take its course?

Mr. JOHNSON. I think it can be best expressed as far as domestic production is concerned by saying that there has been a change in the type of the work and in some types of the work we are doing more than we did before. We are doing less and have practically eliminated physical exploration, that of drilling and developing and finding ore deposits. When we started our program in 1948 industry was doing little exploration because there had been no market, and there were large areas favorable geologically for finding uranium deposits that were vacant public lands. Anybody could have gone in and staked claims. We made the withdrawals, went in and found ore on areas that had no outcrops. But with the interest in the United States in uranium that we have today, all areas that appear favorable are being acquired under the mining laws by private industry and private industry is doing a tremendous job of exploration and development.

For instance, the Government at the peak of its exploration program was drilling about 1 million feet a year in exploration work. As I mentioned in this report, during the last year, private industry drilled in excess of 4 million feet, and probably up around 5 million. So that there is no need for the Government to carry on physical exploration.

What we are doing now is geological work that will aid private exploration. We are also attempting to appraise the potential resources of the country so that we will have the information available as to future supplies. In addition, we are doing cooperative work with foreign countries in the field of exploration. I think that is a cooperative program that is not an assistance program because both sides get value received.

For instance, two of our geologists who had spent about 2 months in a foreign country found nothing of special interest, but the country has possibilities for exploration. The Government is most anxious for us to send down a geologist to work with them for a year. Under programs of that kind, we get the information on what is being found. We are called on for assistance or information if something is developed. If we should need the uranium, I think we are in a good position to buy it.

Representative DURHAM. Who is buying the Australian ore at the present time?

Mr. JOHNSON. It is being bought under the contract of the Combined Development Agency. It is moving to the United States, with some to Great Britain.

Representative DURHAM. Any further questions, Mr. Cole?

Representative COLE. These two new mining locations in Australia are included in the Combined Development contract?

Mr. JOHNSON. No, sir.

Representative COLE. They are not?

Mr. JOHNSON. No, both are private operations. One of them, I think, has no contract for a milling operation. In the other case a private company will probably undertake a milling operation.

Representative COLE. Where are they going to sell their milled product?

Mr. JOHNSON. I believe in one case the product will be sold to Great Britain.

Representative COLE. What will happen in the other case?

Mr. JOHNSON. The development has not proceeded far enough to indicate whether there will be production. It is in an early stage of development.

Representative COLE. Why is it that these two fields are not included in the Combined Development procurement program? Because they were discovered subsequent to the agreement?

Mr. JOHNSON. No. I think the principal reason is that Great Britain, unlike the United States, has had no contracts for uranium except that under the Combined Development Agency. The United States, on the other hand, has domestic production and the Canadian production is sold directly to us. There were some discussions that led to this particular arrangement.

Representative COLE. You believe there was some discussion with respect to this particular arrangement. It leaves me up in the air. It gives me no idea of what you are talking about. Discussion with whom?

Mr. JOHNSON. I believe that the British proceeded to arrange a contract with the private company that was to produce uranium from one of the mills. I believe the British consulted the United States in connection with that contract.

Representative COLE. And presumably consulted Canada, as well?

Mr. JOHNSON. Canada would probably not be a party. I am not sure.

Representative COLE. Is it just Britain and the United States that are in the Combined Development Agency?

Mr. JOHNSON. There is Canada, Britain, and the United States. But in procurement operations, Canada has more or less abstained, being a producing country rather than a purchasing country.

Representative COLE. Under the terms of the Combined Development authority, can you tell us what portion of uranium raw material is assigned to Britain?

Mr. JOHNSON. The policy over the past years in connection with all material purchased by the Combined Development Agency has been to allocate that material between the United States and the United Kingdom on the basis of their requirements. The bulk of it has been coming to the United States on the basis of military requirements.

Mr. STRAUSS. Mr. Cole, we would like to give specific testimony on that in executive session rather than open session.

Representative COLE. I would be happy to hear it, but I hope we can develop as much as we can in a public session to get as widespread an understanding of this arrangement as possible.

Does that mean, then, Mr. Johnson or Mr. Strauss, that the allocation of the raw material covered by this international agreement is limited to the factor of the relative requirements of the two countries for military uses, and is not collated to civilian uses?

Mr. STRAUSS. It has been that way. It might not be continued.

Representative COLE. Does the contract anticipate a review periodically—annually or biannually—of the allocation of this material to the various countries? Is there any provision in the contract?

Mr. STRAUSS. The contract is firm for its life, but there are review periods provided for. The authority meets, I started to say, at regular intervals, meets on call. It is about once a year.

Representative DURHAM. Canada has never exercised to any large degree her right to any ore?

Mr. STRAUSS. Mr. Johnson said they were sellers rather than purchasers.

Representative DURHAM. Although they are a party to the agreement.

Mr. STRAUSS. Yes, sir.

Representative COLE. I assume that no American capital or capital of this Combined Development group has gone into opening of the two new fields of Australia?

Mr. JOHNSON. There is a report that an American company had some options in the Alligator River area. I am not sure whether that company is proceeding with plans for development for production or not.

Representative COLE. When I said American capital, I meant public money.

Mr. JOHNSON. No, no public money. I am sorry. I thought you mean private capital. There is no United States public money in either of the projects.

Representative COLE. Public money has gone into it by way of loans?

Mr. JOHNSON. No United States public money in these two new areas.

Representative COLE. Can it be determined now whether the raw material requirements of Great Britain for civilian uses can be met from these new Australian fields or not, or is it anticipated in the near future Great Britain is going to have to call upon the raw material production now under the control of the Combined Development Authority? What is your answer, or should you not?

Mr. STRAUSS. It would involve a forecast of the rapidity with which their domestic power program can expand, Mr. Cole. I believe that is beyond our competence.

Representative COLE. I would hate to have you make such a confession as that in an open meeting, Mr. Strauss, that it is beyond your competence. You know the British civilian program that has been laid out of 10 reactors, 1 a year for the next 10 years. It is known that up until currently all this raw material has gone into weapons. But now we are beginning to find and need uses of it for civilian purposes. Among the outstanding is Great Britain. She has got to have raw material. She should have it.

I am curious to know whether she will be able to meet those civilian requirements out of the production presently available, other than the production which historically has been going into weapons. Can that be answered?

Mr. STRAUSS. I can't answer it.

Mr. JOHNSON. I believe it is true, Mr. Cole, that there should be no difficulty in meeting the power requirements, as far as I can understand them, that might develop in the world over the next 10 years from areas that are now producing or from production that is now planned.

There are possibilities of expanding Canadian production over the next 5 years that may be beyond commitments that will be made to the United States.

Representative COLE. Does that mean that as you see it, Mr. Johnson, there does not appear to be any likelihood that the flow of raw materials to this country for weapon production will be curtailed?

Mr. JOHNSON. Yes, sir.

Representative DURHAM. Yesterday, Mr. Johnson, we touched upon the related matters like beryllium, boron, thorium, and also zirconium, which you have not touched on here at all, and which are necessary to carry out a program such as we have before us in the next few years.

Could you give us some thought as to what the supply and demand is going to be in these ores? That comes under your department, does it not, or section?

Mr. JOHNSON. With regard to thorium, the Commission has a limited stockpile program, and that stockpile will be filled by the completion of deliveries from contracts now in effect. The Commission is presently not making additional contracts for thorium.

Representative DURHAM. What do you base that on? An objective of how many years?

Mr. JOHNSON. That stockpile will be filled by the end of 1957, I am quite sure, by deliveries from contracts that are now in effect.

With respect to beryllium, the Commission has not been making contracts for beryllium for 3 years or so. The quantities of beryllium in the Commission's stockpile are estimated to be adequate to take care of any experimental and development work that the Commission might undertake. If the material should be needed for operational reactors, presumably the agency that would be interested in those operational reactors would have the responsibility of obtaining the material required for the manufacture of them.

Representative DURHAM. How about zirconium?

Mr. JOHNSON. I have not been involved in the procurement of zirconium. I believe that zirconium ore is in ample supply through normal commercial channels, and there has been no need of an ore-procurement program for zirconium.

Representative DURHAM. That completes that section, does it not? I would like to ask one question here on your release of December 21, 1955, in regard to the land we owned when the old Manhattan project was dissolved, and we took over from them. I notice in your release that you intend to hold this more or less as a stockpile reserve. Is that correct?

Mr. STRAUSS. That was the purpose.

Representative DURHAM. You stated in that release that you were going to make some contract leases for the land. Have you made any since the release?

Mr. STRAUSS. I would like to ask Mr. Johnson, have any leases been made of this land which was mentioned in the December 21 release?

Mr. JOHNSON. No leases have been issued since the announcement of the competitive bidding. As a matter of fact, no new leases have been issued since the end of 1953 because of the large amount of ore being produced from private mines, and the lead time that was required to build new mills to take care of the ore supply from private operations.

Representative DURHAM. Has there ever been any estimate made of the amount of ore on this land that we actually control and have set aside as a reserve.

Mr. JOHNSON. Yes. On all lands that have been leased by the Commission there has been exploration and the leases have been made on the basis of the estimated grade and tonnage of ore contained in the individual leases.

Chairman ANDERSON. I do not believe that was his question. His question was on the land that you are holding out, has there been any estimate of the total production on that?

Mr. JOHNSON. Yes. The reserves have been estimated at something of the order of 700,000 tons of ore as being for the lands that have not yet been leased, although we have a small amount of drilling to complete our exploration program on withdrawn lands. That work will be suspended then.

Representative DURHAM. In other words, that can be more or less classified as a stockpile item, which I think is a good idea, as long as you are getting enough ore now.

Mr. JOHNSON. Our plans are only to issue leases as to ore from leases may be required to maintain milling operations at capacity to meet the defense requirements. Certain areas of the plateau may be deficient in ore, while others will have an abundance of ore, but it may be uneconomic to haul the ore a long distance from one area to another.

Representative DURHAM. Thank you very much. We can now go to isotopes.

Mr. STRAUSS. Dr. Libby will present that.

Chairman ANDERSON. Before you go into that, Mr. Chairman, the other day we were discussing the fact that you had declassified some things and dropped some things from secret to confidential and so forth. Merely so that the committee might have some idea how it works and what the general yardsticks are, would you be prepared at a later date to submit to us in executive session, say, half a dozen cases where you have dropped from secret to completely unclassified, and maybe another half dozen cases where you dropped from secret to confidential and maybe another half dozen, as you mentioned, where you considered it carefully and decided it best not to declassify. I think if the committee saw those, they would understand more clearly some of the problems with which you are wrestling

Mr. STRAUSS. We could submit that in written form within a matter of a day or so, if you care to have it that way.

Chairman ANDERSON. It will be just as good. That will be satisfactory.

Mr. STRAUSS. We will do that.

Representative DURHAM. You are moving in the direction of declassification of all of this information on uranium ore, as I understand the statement.

Mr. STRAUSS. That is correct.

Representative COLE. This discussion prompts an inquiry that I had in mind making yesterday and perhaps I did make it. You said, Mr. Strauss, that within the past year or so, your reviewers have examined some 25,000 items of classified information and have reclassified the proportion you indicated. That prompted me to wonder this: The total number of classified items which your reviewers have before them is how much?

Mr. STRAUSS. I believe the backlog, Mr. Cole, is less than 5,000 documents at the present time. I would like to check that, if Mr. Marshall is here. I don't see him. It is of that order or less. The rate of review has been accelerated beyond the figure that I mentioned in my testimony yesterday.

Representative COLE. So we can anticipate within the very near future the backlog of classified documents and data will be eliminated and the Commission can be current in its classification?

Mr. STRAUSS. Yes. We think by the end of the month we will have reached that happy state. Of course, the review of currently produced material is going on concurrently with this other enterprise.

Representative COLE. I would imagine that is increasing.

Mr. STRAUSS. It is increasing, sir.

Representative COLE. Can you indicate numerically the current monthly classified data?

Mr. STRAUSS. No, sir; I don't know that number, but we will supply it.

Representative COLE. Can you guess at it?

Mr. STRAUSS. I would hesitate to guess. Unfortunately, the officer who would have that information available was not brought here this afternoon, since we thought we had covered it. Perhaps I can get it before the close of the session. I will get it before the close of the session.

Chairman ANDERSON. Thank you. We will proceed on isotopes.

STATEMENT OF DR. WILLARD LIBBY, COMMISSIONER, ATOMIC ENERGY COMMISSION

Dr. LIBBY. I would suggest, Mr. Chairman, that this section be introduced in the record if it suits your pleasure. I would like to make one general remark about the use of isotopes. It is one of the few peaceful uses of atomic energy we have realized and are now benefiting from in a very practical way. I think we can show that isotopes are benefiting the American industry and the farmer to the extent of several hundred million dollars per year right now. So we do have something tangible in the way of peaceful uses from the atom already, and the isotope uses this item.

Representative COLE. Excuse me, Dr. Libby. With respect to the use of isotopes in industry and agriculture resulting in a saving of several hundred million dollars a year, I note your statement refers to a speech—I am not sure of your predecessor—Commissioner Camp-

bell or at least former Commissioner Campbell, in which in August 1954, he estimated that the saving was $100 million a year.

Dr. LIBBY. Yes, sir.

Representative COLE. I speak of this to focus attention on your statement which indicates that a year and a half later the use of isotopes in industry and agriculture has resulted in a saving not of $100 million a year, but as you say, several hundred million dollars a year.

Dr. LIBBY. Yes, sir.

Representative COLE. Providing very graphic demonstration of the tremendous value which atomic energy through a byproduct has made to nonmilitary functions and uses.

Dr. LIBBY. Yes.

Representative COLE. Could you be a little more specific in what you classify as several hundred million dollars so that 2 years from now we can compare the estimate of, I hope not of your successor, but your estimate of that time with what you estimate today?

Dr. LIBBY. Of course, it is to be realized that these are estimates, and difficult to make quantitative. We can foresee uses in agriculture alone of the order of $200 million a year, which will be realizable in the foreseeable future. It is difficult to say what fraction of the $200 million we have realized at the moment. These things are coming into practice very rapidly.

So in agriculture alone we might write down $100 million at the moment.

As you point out, Commissioner Campbell's statement was made in August 1954, and we have reason to believe that has increased very considerably in the meantime. I would estimate that the number is between two and three hundred million dollars at the present time. But it is an estimate. I would be glad to break it down more particularly if you wish.

Representative COLE. Didn't the panel someplace recently, or at least I read an estimate to the effect that the use of isotopes in the next decade would result in savings of $1 billion a year to our general economy.

Dr. LIBBY. With this estimate I agree. I agree with that estimate.

Representative COLE. Who is the authority for that estimate?

Dr. LIBBY. It is a question of understanding, I think, what the probable uses may be which are yet unborn. Nobody understands this, but looking at the uses that have been made, you can make guesses as to possibilities in the future which have not yet been realized.

Representative COLE. What I am seeking is confirmation or denial of whether that estimate was made by the McKinney Panel.

Dr. LIBBY. That may have been my estimate. I think I told the panel this as my opinion. I am not sure I was the only authority.

Representative COLE. Perhaps it was one of your speeches that I read.

Dr. LIBBY. It could possibly have been, sir.

Representative COLE. At any rate, you concur.

Dr. LIBBY. I certainly do; yes, sir.

Representative DURHAM. At the present time, is the American public taking full advantage of what we are offering to them, because there has been no shortage of these isotopes.

Dr. LIBBY. No. It is a good bit like atomic power in a way. If we had atomic power we would still have to educate people to use it.

There is an educational problem involved. The problem of the development of the uses themselves is involved. These uses have to be invented. This takes time. There is the problem of the development of instruments for measurement of isotopes. There is a group of problems of this type which take time. Fundamentally, of course, we have plenty of isotopes, and there is nothing except education, administrative problems, and inventions which lies in the way of this great peacetime benefit.

Representative DURHAM. Qualified users.

Dr. LIBBY. That is right. There is nothing in the way of an acceleration of this that we can't take care of by hard work. The Commission is trying very hard to accelerate uses in every way it can.

I think that we all should realize that isotopes are really a very important benefit of the atom.

Representative DURHAM. Where would you say the qualified users are short? Is it in what you might term the masters degrees or doctors degrees or the basic research?

Dr. LIBBY. I think there are two points. One is that we must teach students in schools to use them as they go through their normal school courses. The other point is to educate the people who have been in industry and have been practicing for a time as to the possibilities which are latent here for making money, and for doing things more easily and making better products. I think both adult education and education of adolescent students is required.

We can see already an opening of tremendous new uses in industry. During the last year there has been an enormous increase, relatively speaking, in the industrial utilization of isotopes.

Chairman ANDERSON. Dr. Libby, it seems to me you had almost started on a good freewheeling statement as to why you think these isotopes might save this country a billion dollars. I would just as soon have that as almost anything because this country has got $12 billion or $15 billion invested in this business. If it was to return 4 or 5 percent over the next 10 years, it might get a few billion dollars in return. You have almost indicated a way by which a very handsome return could come to the American taxpayer for his investment. I don't wish to break up what you had in mind, but I thought I caught you almost about to take off, and if you were, I would rather have that than almost anything I know.

Dr. LIBBY. Senator Anderson, as I was saying, a few minutes ago, it appears to me we are realizing something between two and three hundred million dollars a year now. In 5 years I don't see any doubt that this will be increased fivefold by a proliferation of the present uses and by the invention of new ones. For example, we do not now use industrially in any important and serious way the isotopes of two of the most important elements in the periodic table, namely, carbon and hydrogen. They are used in medicine. I am talking about industrial processing and agriculture as a matter of monetary savings.

I should point out that the medical benefits are priceless in themselves and do not come into this account I am making here.

The whole organic chemicals industry which is a major part of the enormous chemical industry in this country has not yet realized the possibilities of using these two substances in their routine manufacturing operations.

Representative DURHAM. Why?

Dr. LIBBY. It is difficult. They are cheap, they are available. It is a question, I think, as I said before, of inventing the new uses and of getting the instruments available and there are a host of things at the moment which will be removed in due course. I think we can expect without any doubt that these benefits will be made. We will start reaping profits and savings which I think will make my statement of a billion dollars a year look modest.

Representative DURHAM. It looks like a good chemist should have that much appreciation. It is naturally a concern that manufacturing high-type chemicals ought to have it.

Dr. LIBBY. There are many aspects to it. There is the cost of the isotopes. We have just reduced the cost of these isotopes. The isotope of hydrogen, tritium, is the cheapest isotope you can buy. I think the price is 2 mills per millicurie. It is the cheapest isotope you can buy. With tritium, you can trace any organic chemical. You can trace water. You can do all sorts of important practical things.

Representative DURHAM. Doesn't it speed up basic research?

Dr. LIBBY. It has tremendous uses in basic research. I was, however, addressing myself to the question of actual dollar savings in industrial processing and agriculture.

Representative DURHAM. That is what I was thinking of.

Dr. LIBBY. Of course, in medicine, we have benefits which are priceless. It is very difficult to put a price tag on these things. We all know that the medical benefits for isotopes have been extremely important and will increase. So I have no doubt that even if we should—and I am sure we won't—even if we should fail to get atomic power, isotopes will have paid us for the atomic energy development.

Representative COLE. Will you say that once more, and a little louder?

Chairman ANDERSON. It might be someone at the press table did not get that. That is a good statement.

Representative COLE. Just the last part.

Dr. LIBBY. I am completely persuaded we are going to have atomic power, and I am doing everything I personally can to help get it. But even if we should fail, isotopes themselves will pay the way for the atom.

Chairman ANDERSON. I think that is a fine statement because the American people have a lot of money invested in this, and they think now it is only an instrument for destruction. A great many people do, at least. Here you have said, which I think is important, that even if we get up to $20 billion invested in this industry, we can have a nice 5-percent return on our investment every year on just the fivefold expansion you have mentioned. You did not try to add a dollar value for medicine, which to me is as much again. You did not try to add what the value of the defense has been to this country. So all in all it is a pretty fine business.

Dr. LIBBY. I would want you to know that this is my personal opinion, but I firmly believe it, and I think that this will be borne out without any real doubt.

Representative COLE. What is teletherapy?

Dr. LIBBY. This is a technique of irradiating for cancer.

Representative COLE. Heat radiation or deep radiation?

Dr. LIBBY. Deep radiation. It is for general medical purposes.

Representative COLE. As a matter of personal curiosity, tell me how it is that you can use isotopes to determine whether the ashes of a certain Indian village were the result of fires that were built in 1452 as against the year 1569.

Chairman ANDERSON. And do that in about 30 seconds.

Representative COLE. Those dates being purely fictitious, but the idea is involved. I read some place that through the use of isotopes the historians have been able to identify a certain Indian tribe was in a certain locality in this part of the country.

Mr. STRAUSS. I will add a footnote to this which Dr. Libby will not. He is the man who discovered how to do it.

Representative COLE. I am sure he can tell us in a sentence how it is done.

Dr. LIBBY. The cosmic rays produce radioactive carbon in all living things. The radioactive carbon has a half life of 5,600 years. At the time you died, you quit eating, and therefore you injest no more radioactive carbon. However, the decay process goes on, and so your body after 5,600 years has just half as much radioactive carbon in it as when you died. For example, some ancient Egyptian mummies have been actually measured and shown to have half as much radioactive carbon in them as present living people. So by measuring the radioactivity you can determine how long it has been since the life processes have ceased. This is how you determine the age.

Representative COLE. Through the ashes of the human body?

Dr. LIBBY. They must contain carbon, Mr. Cole. The usual thing is to use hair or flesh or something like that.

Representative COLE. And the skeleton?

Dr. LIBBY. The bone contains relatively little carbon. It is difficult to use.

Representative COLE. I have a general idea.

I would assume that it would be reasonably accurate as a method of estimating.

Dr. LIBBY. It is accurate to about 1 or 2 centuries. It can be made to one century.

Representative COLE. That is not so much when you talk about 5,600 years. But when you talk about 1,000 years, that is different.

Dr. LIBBY. It is quite an error for recent materials.

Chairman ANDERSON. Thank you, Doctor. We appreciate that. You go ahead with your regular isotope paper. This has been very interesting.

Dr. LIBBY. Thank you, sir. I would like to suggest that you just introduce it into the record, Mr. Chairman, if that suits your purpose.

Chairman ANDERSON. Yes.

(The statement referred to follows:)

VII. ISOTOPES IN INDUSTRY, MEDICINE, AND AGRICULTURE

During the past year, the use of isotopes continued to expand in various fields, including industrial applications, agricultural research, and medical research, diagnosis and therapy. Shipments from Oak Ridge National Laboratory reached a new high, and private industry actively increased materially in the production of radioisotope-labeled compounds and pharmaceuticals and of various devices utilizing radioisotopes as sources of radiation. In April, the Commission instituted a new policy of selling radioisotopes for all biomedical and agricultural research at 20 percent of the catalog price. This discount previously applied only to radioisotopes used in cancer studies. Early in 1956,

the Commission simplified its procurement procedures for foreign radioisotope users and increased the availabiliy of radioistopes for domestic use.

Increase in distribution

The Isotopes Division issued a total of 8,842 individual authorizations for procurement of isotopes in 1955, in comparison with 8,195 during 1954. Of the 1955 authorization, 8,178 were for domestic use, in the following categories:

Type of user	Radioisotope authorizations	Stable isotope authorizations
Medical institutions and physicians	3,895	55
Colleges and universities	925	529
Industrial firms	1,726	188
Federal and State laboratories	316	73
Foundations and institutions	185	17
Other domestic users	33	236

A total of 576 radioactive and 88 stable isotope authorizations were issued to 38 countries. Fifty-seven countries now are authorized to receive isotopes.

Shipments from Oak Ridge National Laboratory alone totaled about 15,600 in 1955, an increase of approximately 6 percent over the previous year. Also, the total number of curies per shipment increased from about two and one-third in 1954 to about three in 1955. Secondary suppliers, who process radioisotopes obtained in bulk quantities from AEC facilities, now make many more shipments than Oak Ridge National Laboratory. It is estimated that more than 50,000 isotope shipments per year are being made to ultimate users from these suppliers and the AEC.

In the first year of radioisotope distribution only about 100 United States institutions received shipments. In slightly less than a decade, this number has grown to 3,000, including about 1,150 medical institutions and 1,250 industrial firms. Many of these institutions have several groups of users, and the total number of groups using radioisotopes at present in this country is estimated at about 5,500.

Another measure of the wide utilization of isotopes is the number of papers relating to work with isotopes published in scientific and technical journals. About 11,000 papers have been published in the past 9 years. More than 60 percent are in fields directly related to biology and medicine, including agriculture, and the remainder fall mostly into the fields of science and technology.

Industrial utilization of isotopes

The most striking trend in isotope distribution has been the recent growth in industrial uses. In 1950, only about 100 firms were using radioisotopes. The number has increased twelvefold in just 5 years.

Through the use of radioisotopes, significant industrial developments have occurred in radiography, various types of gaging, luminescence, ion tube operation, activation of chemical reactions, sterilization of foodstuffs, radioisotope battery development, wear studies, pipeline movement of petroleum products, oil well studies and treatment, leak location and pipeline tracing, and control of gas stored in underground cavities. There has been a marked increase in use of devices for gaging operations and density control.

Industry also has benefited from the wide use of radioisotopes in physical and chemical research. In the field of physical chemistry, for example, much new information has been learned about atom exchange, aging of precipitates, surface reactions, diffusion, vapor pressure, thermodynamic properties, and activation of chemical reactions.

Former Commissioner Campbell, in a speech given in August 1954, estimated that United States industry was saving approximately $100 million annually through the use of isotopes. This annual saving is expected to increase tenfold during the next 10 years.

In the future, large increases can be expected in the industrial use of such isotopes as cobalt 60, cesium 137, hydrogen 3 (tritium), strontium 90, and carbon 14. Industrial use of fission products from reactor fuel processing, now just beginning, should far overshadow in activity the total curies distributed to date.

Very recent developments in low-level radiation counting (counting just above the natural or background radiation level) hold considerable promise for a large

number of additional applications in industry and medicine. Using these very sensitive methods, tracer tests can be carried out during actual processing.

Industrial participation

There has been a rapid increase in private industrial participation in the processing of radioisotopes and the production of special compounds and radiation sources. The Commission has followed its usual practice of withdrawing from fields where private activity has advanced sufficiently to be capable of supplying the demand.

Significant industrial participation has occurred in the following areas:

Labeled compounds.—Industrial firms as well as universities and research centers have contributed to developing new isotope-labeled compounds and improving existing production techniques. It is no longer necessary for AEC laboratories to supply special isotope compounds. The stockpile of compounds remaining at ORNL was disposed of through sealed-bid public sale. Nearly 1,000 labeled compounds are currently available from approximately 25 commercial suppliers.

Pharmaceuticals.—Bulk shipments of unrefined radioisotopes are purchased from AEC laboratories by secondary suppliers, processed as pharmaceuticals, calibrated, and reshipped in small quantities to hundreds of individual users. One commercial firm, for example, is currently making more than 2,000 shipments per month.

Processed cyclotron radioisotopes.—AEC distribution has been discontinued. This is an activity which it appears may now be performed by private groups.

Radiation detection instruments.—The use of radioisotopes has been closely related to the development of radiation detection instruments, although such instruments have a variety of uses in addition to isotope applications. For example, there has been extensive use of radiation detection instruments in prospecting for radioactive minerals and oil. Health and safety applications of instruments and uses in connection with the operation of all types of reactors also are important. Some instruments, such as thickness gages and level indicators, already have become widely accepted for improving production methods. Many other industrial applications of nuclear instrument techniques undoubtedly will be developed.

In medicine, new clinical and therapeutic methods employing nuclear instrument techniques and radioisotopes are being developed nearly every month, and are being rapidly placed in use by many of the leading hospitals and clinics in this country.

The radiation detection instrument industry has grown rapidly in recent years. More than 100 companies now are manufacturing radiation detection instruments, and more than 1,000 types of instruments are on the market. The total annual volume of business in nuclear instrumentation has increased rapidly. The volume of business was close to $20 million in 1952; $30 million in 1954, and $32 million in 1955.

The number of persons employed in this new industry has increased with the annual volume of business. By 1960 the industry will probably employ 4,000 persons, and the annual volume of business may be $50 million.

Teletherapy units.—Seven United States firms are collaborating with radiophysicists and therapists in developing gamma radiation devices for medical purposes. The numerous variables, such as energy of radiation, specific activity of the radioisotope, stationary versus rotation therapy, and protection of patient and personnel, permit consideration of many possible uses. The active development of teletherapy units incorporating large sources of radioisotopes shows much promise.

Radiography exposure devices or gamma-ray cameras.—Several companies in the United States now make and sell such devices. More than 400 industrial firms in the United States use radioisotopes for radiography. These are widely used throughout industry for checking welds and castings.

Radioactive thickness gages.—Six commercial firms are currently producing such gages. They are being used routinely by more than 350 companies for thickness monitoring, especially in sheet processing by industries with products such as steel, aluminum, and other metals, plastics, paper, cloth and floor covering.

Gamma-ray density gages.—These have been developed to record continuously the density, and thus the weight, of such things as water content in snow, bagasse, foam rubber, cigarettes, and ice cream. The product can be measured in containers or while flowing in closed circuits

Radiothulium portable X-ray unit.—This device having an energy comparable to the 50-kilovolt X-ray unit, was developed approximately 2 years ago at Ar-

gonne National Laboratory. It has been of interest to industry from the standpoint of production of the units on a commercial scale and also as a tool to assist in certain research and development operations. Medical uses of this unit would be limited to preliminary diagnostic work where conventional X-ray equipment is not available. The Army has studied the possible usefulness of this device as a portable field instrument.

Medical applicators.—Various types of these are now being manufactured by several commercial firms. Such devices include eye applicators for treating ophthalmic lesions, beta-ray plaques for treating a variety of skin disorders, custom-designed radiation needles for interstitial uses, colpostats for special medical use, a variety of radioisotopes sealed in plastic tubing for use as sutures, shielded syringes, and a variety of other special devices.

Irradiation facilities.—Several firms have installed commercial irradiation facilities for research and development and many more are being planned. In studies of food and beverage irradiation 23 universities, 8 research institutes, 7 industrial firms, and 8 Federal laboratories conducted research during the year. Several firms are conducting research on radiation sterilization of drugs.

Other materials and services account for a growing commercial business related to isotopes. These include the production of radiation measuring instruments, luminescent markers, static eliminators, and atomic batteries. Services include consultation, film meter service and radioisotope waste disposal.

AEC production and service facilities

Additional radioisotopes and more reactors and other irradiation and processing facilities became available during 1955. Notable among these additions are the gamma irradiation facility at Idaho Falls, which utilizes cooling fuel elements from the MTR to produce a field of 10 million roentgens per hour, and the similar facility at Argonne in which up to 12 of the MTR fuel elements are used to produce a field of 1 to 2 million roentgens per hour.

The production of cobalt 60, especially for sources in the range of 1,000 curies or more, remains below the demand for this material for use in teletherapy devices and gamma irradiation facilities. All of the high specific activity cobalt made available through Oak Ridge National Laboratory to date have been produced in the materials testing reactor at the National Reactor Testing Station in Idaho. On the basis of present and anticipated demands, production of 50,000 curies per year, with a specific fravity of 50 curies or more per gram, has been scheduled from the MTR. During 1955 arrangements were made to supplement this amount by cobalt 60 produced at Savannah River. More than 100,000 curies of cobalt 60, with a specific activity of 40 curies per gram, will be available from Savannah River by June of 1956.

The research reactor (RR) being built at Oak Ridge National Laboratory for research and materials testing will have a neutron flux of about 3.3×10^{13} (33 trillion) neutrons per square centimeter per second. This is about double that previously available at Oak Ridge for research and materials testing. The new iodine 131 processing plant now operating at ORNL has a design capacity of 25 curies per week, about 10 times the former possible output.

The fission product pilot plant at ORNL is expected to go into operation in 1957. The plant is designed to separate 200,000 curies of cesium 137 per year, as well as other long-lived fission products, from reactor wastes. Appreciable quantities of fission products already have been produced and delivered from subpilot plant operations. The new 10,000 curie loading cell, also at ORNL, is designed to load high activity sources into teletherapy equipment and other gamma irradiation devices. Industrial firms encapsulate all but the very large gamma ray sources.

Brookhaven National Laboratory has continued to develop processes whereby new radioisotopes can be added to the available list. Fluorine 18, for example, can now be procured there. This emitter of positrons, which has a half life of 112 minutes, is the only isotope of fluorine long-lived enough for tracer use. Iodine 132, with a half life of 140 minutes is now obtainable from the longer-lived parent tellurium-132. Because of its shorter half life, iodine 132 is more useful in many diagnostic and other applications than the better known iodine 131, which has a half life of 8 days. Iodine 133 and pure arsenic 77 can be added to the list if there should be a demand.

The few remaining limitations on isotope availability are being eliminated as rapidly as possible. Tritium in quantities up to 2 liters (approximately 5,000 curies) can now be procured by an individual applicant. Special limitations on procurement of helium 3 and polonium 210 have been removed.

In January 1956 the Commission announced issuance of a revised regulation which removed certain restrictions on the sale of radioisotopes abroad and simplified procedures governing domestic radioisotope distribution. Except when exporting to Soviet-bloc countries, Commission licensees now are able to ship radioisotopes with atomic numbers of 3 to 83, inclusive, directly to persons abroad. The regulation also raises the limit on quantities of radioactive materials available to domestic users under general license.

Radioisotope research support program

In a letter dated August 16, 1954, the Joint Committee on Atomic Energy recommended to the Commission that discounts in the price of radioisotopes, previously limited to the field of cancer, be extended to include all medical research, and suggested that consideration be given to the inclusion of selected other fields, such as biology.

The Commission concurred in this recommendation and in 1955 inaugurated a program allowing scientists and research institutions to purchase radioisotopes at a discount of 80 percent for use in research in medical fields including therapy and diagnosis, in biology, and in agriculture. Response to date has not been in the volume anticipated, but growth of the program has been steady. Some 450 medical projects and 125 projects covering agricultural and biological fields have requested and are receiving isotopes at a discount under the new program.

Medical uses of radioisotopes

Radioisotopes have become important tools in many areas of biological and medical research and medical diagnosis and therapy. Their use has enabled research workers to gain new understanding of life processes. Radioisotope techniques have become almost routine in certain types of diagnosis and therapy, and these applications are almost certain to increase materially in the future.

In biological and medical research significant new knowledge has been gained from studying with radioactive tracers the metabolism of iron and calcium compounds, proteins, hormones, cholesterols, nucleic and citric acids, red blood cells, anticancer agents, carcinogens, and radiation damage.

Metabolic studies.—Radiocarbon (C14) has been used to study what happens to many biologically important compounds in experimental animals. These studies have resulted in much useful information about fundamental metabolic processes and their regulation. However, it is not usually possible to duplicate in a laboratory animal a disease or condition as it occurs in a human being. More useful information is obtained when circumstances permit the use of tracers in human subjects, as for example, in the use of radioiodine to study human thyroid disease.

The use of radiocarbon in human subjects was limited until recently because instruments and methods were not sensitive enough to measure the small amounts of radioactivity which had to be used. This problem has been solved by the development of new radiocarbon counting methods and devices, at least 10 times as sensitive as the previous ones. For example, liquid scintillation and gas phase counters measure about 90 percent of all the carbon 14 disintegrations, compared with 5 percent or less for conventional Geiger-Mueller tubes. These new methods also offer practical means for counting tritium. This tracer emits an extremely weak beta ray, only one-tenth as energetic as that from carbon 14, but it can now be measured with good efficiency. With these improved counting techniques it is now possible to follow in a human being a tracer dose of carbon 14 or tritium hundreds and thousands of times smaller than the maximum recommended activity.

One group of compounds under investigation with these techniques is the steroids, which are the basis for many different compounds, such as cholesterol, vitamin D, and the adrenal hormones, cortisone, and a variety of male and female sex hormones. These steroid hormones are of particular interest. They have been shown to be important both in the development and in the treatment of certain types of human cancer. The use of carbon 14 and tritium in these studies is not an easy task but without them such research would be extremely difficult. The rapid development of methods of separation and analysis of these compounds, simultaneously with the new methods of radioisotope measurement, now make it possible to follow the synthesis and breakdown of the individual steroid compounds.

Clinical applications.—In clinical diagnosis significant developments have occurred in the use of radioisotopes for determining the following: blood volume, body water, cardiac output, peripheral vascular disorders, thyroid disorders, delineation of organs, and location and extent of malignancies.

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In medical therapy radioisotopes are being used primarily for treatment of hyperthyroidism, certain heart disorders, various cancerous conditions, and ophthalmic disorders.

There also have been noteworthy developments in the use of high-activity cobalt 60 in teletherapy. Currently there are in operation in this country 44 teletherapy units designed for therapeutic use. Twenty of these units contain high energy gamma sources made up of high specific activity cobalt 60, which total from 1,000 to 2,000 curies per source. Fourteen of the sources in this group were produced in the United States and 6 in Canada. The remaining 24 range from 950 curies per unit down to some 300 curies. Of this group 19 were prepared in this country and 5 in Canada.

Parallel to the cobalt 60 program is the contemplated use of cesium 137 for therapeutic purposes. The first cesium source, installed at the Oak Ridge Institute of Nuclear Studies, has an activity of 1,540 curies. The second source, of some 2,000 curies, with a specific activity of approximately 25 curies per gram, was recently delivered to the University of Michigan, where a clinical evaluation is being made of various gamma sources for the treatment of selected patients. Presumably cesium will in part replace cobalt as a more desirable source, primarily because of its much longer half life. (Thirty-seven years for cesium as compared with 5.2 years for cobalt.)

It is very difficult to estimate the future needs for either cobalt or cesium, but it is believed that, once the production of cesium in substantial quantities becomes a reality and with the guaranteed production of 50,000 curies per year of cobalt 60, there will soon be adequate sources to serve the needs of hospitals in this country.

Agricultural uses of radioisotopes

In plant studies significant developments have occurred in the following areas: metabolism and translocation of mineral nutrients in plants, uptake of fertilizers, soil fertility, action of growth regulators and herbicides, plant diseases and fungicides, radiation effects and genetics, moisture distribution, root growth, and photosynthesis. A more detailed discussion of developments in this field follows.

Crop improvement.—At Brookhaven National Laboratory, a cooperative program has been developed with the agricultural experiment stations of the Eastern States for use of the Brookhaven reactor and the gamma field in crop improvement studies. Seeds are sent from the experiment stations and from other countries for irradiation in the reactor, and plants from experiment stations are grown and irradiated in the gamma field. The irradiated seeds and plants then go back to the experiment stations where subsequent generations are studied to determine whether or not desirable mutations have been produced. Recently a gamma field has been established at Oak Ridge for similar cooperative studies with 17 southern agricultural experiment stations.

The principles for the induction of beneficial mutations have been worked out for a number of plants. Improved varieties have been produced by radiations especially by Swedish and American plant breeders. Among the useful genetic changes induced by radiation are:

1. Barley: Dense heads, stiff straw, tall straw, higher yield of grain and straw.
2. Oats: Earliness, higher yield, stem-rust resistance, short stems.
3. Wheat: Stem-rust resistance, higher yield.
4. Corn: Shorter stalks, taller stalks, earlier ripening, later ripening, resistance to lodging (toppling or leaning of stalks).
5. Peanuts: Leaf-spot resistance, higher yield.

Work is now in progress at the Brookhaven National Laboratory on producing mutations in vegetatively propagated species of plants; that is, those propagated by cuttings or grafts. Among the species being tested by exposure to a cobalt 60 source are apples, peaches, grapes, blueberries, and carnations.

Plant nutrients.—Radioisotopes have provided for the first time a means of measuring what proportion of its nutrients the plant derives from the soil and what proportion is taken up from the fertilizer. They provide a method of determining the most effective means and the best time of applying fertilizers to various crops.

It has been commonly believed that plants absorb nutrients principally through their roots. Recent studies using radioisotopes have shown that the leaves of plants are important pathways for the entry of nutrients. The surface area of the above-ground portions of trees and many plants may be several times

greater than that of the roots. (It is estimated that the total leaf surface of a 12-year-old apple tree may be about one-tenth acre in area). Research with isotopes has shown that nitrogen, phosphorus, potassium, and rubidium are readily absorbed by leaves, and are freely transported to other parts of the plant. On the other hand, calcium, strontium, and barium are very poorly absorbed in most plants and move very slowly in the plant, indicating that application of these nutrients to leaves is not effective. Such information may lead to changes in the methods of application of fertilizers.

The mechanism whereby plants use certain trace elements, such as zinc, boron, copper, and iron, is being determined by scientists working with radioisotopes. For example, in some areas crops suffer from a lack of iron even though the amount of iron in the soil is not especially low. Recently it has been found that plants may not be able to take up iron from soils that are high in calcium.

Photosynthesis.—Photosynthesis (the means by which plants in the presence of sunlight utilize carbon dioxide and water to form sugars, starches, and fats, and then with nitrogen to form the essential building blocks of some 13 amino acids as proteins) is probably the most important biological process on earth. The use of radiocarbon 14 makes it possible to study the complex pathways of photosynthesis. Plants grown in an atmosphere containing carbon 14 in the carbon dioxide will utilize the labeled carbon in forming foodstuffs. The complexity of the system is apparent in the fact that in a few seconds a plant will fix carbon dioxide in the form of 10 or more compounds in quantities that can be isolated and identified. Radiocarbon makes it possible to distinguish between those compounds that are present before exposure to the radioactive atmosphere and those formed during the experiment.

Insecticides.—The tagging of insecticides permits evaluation of the efficiency of the method of application and study of the uptake and metabolism by the insect. Such information makes a definite contribution to the development of more effective agents and methods of use. Radiocarbon is being used to study how insects develop resistance to specific insecticides, such as DDT. The radioisotope makes it possible to compare the uptake and metabolism of DDT by strains of both susceptible and resistant flies.

Systemic insecticides and pesticides (compounds that are absorbed by the plant or animal and destroy the insect feeding on it) promise significant gains in the continuing war on plant and animal pests, but basic information on the uptake, translocation, and metabolism of these compounds by the host plant or animal is essential. Radioactive tracer techniques are indispensable in obtaining this information.

Radioisotopes are playing an important role in fundamental research in animal metabolism which, in years to come, undoubtedly will contribute to increased production through the use of better, more economical feeds and management practices. Until radioactive forms of such elements as phosphorous, calcium, and sulfur became available, it was possible only to speculate on the processes involved in their use by animals.

Studies on milk formation by cows provide a good example of the effectiveness of tracer techniques. Carbon 14 is used to label feeds. Examination of the milk, tissue, and body fluids for radioactivity shows whether the labeled components contribute directly to milk production and often indicates the metabolic pathways involved. Results obtained with the whole animal and with the isolated udder may be compared. In this way, diet components directly utilized by the udder may be differentiated from those that require modification by microbial action in the rumen or other metabolic action in the body before becoming milk components.

Radioiodine is being used in the development of strains of cattle that are high milk producers and have a high tolerance for heat. European breeds of cattle which are most common in the United States have a lower heat tolerance than Indian breeds. Since the thyroid gland activity of the Indian and European breeds differs, iodine 131 can be used as a quick measure for desired characteristics of the Indian breeds; these then can be introduced into European breeds by crossbreeding and selection.

The use of inorganic sulfate tagged with radiosulfur has shown that nonruminants are capable of synthesizing at least part of the essential amino acid, cystine, from this source. This indicates the possibility of reducing feed costs by substituting an inexpensive inorganic material for a part, at least, of the more costly organic materials.

Radioisotopes are being used in a variety of ways to study plant diseases. In the Midwest the stand of oak trees is being threatened by a virus disease called

oak wilt. Through the use of radiophosphorus, evidence has been obtained that the virus passes from a diseased tree to an adjacent healthy tree through joined root systems. It is probable that radioisotopes will play an important part in finding a way of controlling the disease.

Carbon–14 rubber studies.—The assimilation of carbon and the formation and turnover of rubber in rubber trees have been investigated in cooperation with the United States Department of Agriculture and the Quartermaster Corps, United States Army. Rubber seedlings and old stumps which had released new shoots were grown at Argonne National Laboratory in an atmosphere containing radioactive carbon dioxide. These experiments supplied information on formation and turnover of rubber which will be available for use in various technological studies.

The radioactive carbon was found first in leaf rubber and only later in stem rubber. Previously, it was thought that rubber formation occurs only in the bark. The tracer studies indicate that the leaf not only possesses the complete biochemical pathway for rubber formation, but that it also may be the chief source of a specific substance required for rubber formation at other places in the plant. A field study was carried out in cooperation with the Federal Experiment Station, United States Department of Agriculture, Mayaguez, Puerto Rico. The experimental evidence suggests that the radioactive carbon assimilated by rubber trees is formed initially into rubber of high rather than low molecular weight.

Other studies were designed to determine whether rubber formed in the plant is broken down later. The data suggest that starved plants may break down at least a fraction of the formed rubber.

In the course of these investigations, a quantity of carbon-14-labeled rubber will be formed. It will be released to the Quartermaster Corps for distribution and use in tracer studies on the breakdown of rubber in products under varied environmental conditions. Portions of the tissues from the radioactive rubber plants have been sent to the New South Wales University of Technology in Australia, where an attempt will be made to isolate and identify the inositols present in the tissues. Inositols are sugar-like compounds found naturally in many plant and animal tissues; in some chemical forms they act as vitamins (part of the B complex). Portions of the purified compounds will be returned for distribution to other investigators. The use of the labeled inositols promises to give useful information both in plant and in animal studies.

Chairman ANDERSON. I want you to comment on as much as you desire.

Dr. LIBBY. We have here as the principal point that we have liberalized the isotopes distribution policy. We have raised the amounts of isotopes which can be distributed without specific license, bearing in mind health hazards, and taking care that there is no risk to the health of any sort. We have liberalized the distribution abroad, so that it is now desirable for people in Europe to use our isotopes as compared to those of the British or French.

We will note with interest what effects this liberalization has had on the foreign distribution. We observe a very very large number of isotope shipments. There were nearly 50,000 isotope shipments in the last year. Most of these are made from secondary suppliers who buy large amounts of isotopes, and make them into compounds, and then distribute them.

There is quite a large industry in the manufacture of radiation detection instruments. We have about $30 million a year in that business, or over 100 companies, manufacturing more than 1,000 different kinds of instruments. We expect that by 1960 there will be perhaps 4,000 people employed in that industry.

Representative DURHAM. Are those of reliable instruments, Dr. Libby?

Dr. LIBBY. Yes, sir. The only difficulty I would say in general is that they are somewhat too expensive for the volume use. Let us take civilian defense and the problem of instruments for civilian defense,

which is an important problem and that depends on getting a good reliable cheap instrument, but it has to be cheap.

Chairman ANDERSON. Something like a poor man's Geiger counter.

Dr. LIBBY. That is right, and in prospecting for uranium these prices must be brought down. Volume production will help on that. So we expect that prices will naturally come down with this increase I was mentioning a few minutes ago.

Chairman ANDERSON. Doctor, you mentioned the great growth that there might be in the isotope industry. Do you think that the facilities are being planned so that you will be able to produce the isotopes for this greatly expanded industry?

Dr. LIBBY. I have no doubt that we can keep well ahead of it. I may be overly optimistic, but there is no evidence that we cannot keep well ahead of it. One of the most interesting new developments was the use of radiation to activate chemical reactions—this has been developed very largely by industry itself—the use of radiation in place of chemicals to catalyze the formation of plastics. The production of plastics normally involves the addition of chemicals.

Representative DURHAM. What does it give, strength?

Dr. LIBBY. It gives very superior physical properties. Very superior physical properties result from the use of radiation than from the standard procedure. It may have some cost advantages. It looks like a very promising peaceful use in chemical business of some volume. We may have a very considerable activity in the utilization of radiation from cobalt and from other radioactive materials to induce chemical reactions. It looks very promising.

Representative COLE. Is this the place for me to inquire with respect to something that I heard, that plastics might be used to replace structural steel in the construction of buildings?

Dr. LIBBY. I would not know, really, but you can strengthen them amazingly because of the superior physical properties that can be gotten. For example, the simple irradiation of ordinary plastics like polyethylene, will very definitely harden them. There is a process which goes on as a result of the radiation which has this effect. There is an entirely new type of polymerization reaction that is possible using radiation. That is, whole families of new kinds of plastics can now be made using this type of process. I think the thing is most promising. I think that we ought to and will do everything we can to assist this very promising new development.

I think those are the highlights. There are a host of other questions which could be discussed, but I believe they are the main points. I might mention the development at Oak Ridge of a fission product pilot plant for the production, isolation, and packaging of radioactive cesium. That is a fission product which has a 35-year half-life. It is produced in very good yield. This can be used in place of cobalt. Cobalt is in rather short, tight demand right now. This use of one of the fission products may help us a great deal in this bind.

Representative DURHAM. You are going to get that from waste?

Dr. LIBBY. Yes; it has always seemed reasonable that instead of throwing the fission products away or putting them in waste tanks and burying them, it would be sensible to use some of the fission products for radiation purposes.

Representative DURHAM. How about heat resistance? Has it the same qualities as cobalt?

Dr. LIBBY. No, it is entirely different chemically, so there will be some uses that it will not adapt itself to as well as cobalt.

Representative DURHAM. Does it have a longer life?

Dr. LIBBY. It has a longer life. I believe we are putting it up in the form of cesium iodide crystals. It is a white salt. It does not have the same physical properties, but for general radiation purposes, it looks very promising, and will help us with the task of supplying radiation sources. If you get one large-scale use, such as the induction of chemical reactions by radiation, the amount of material you need for radiation sources is just enormous. It makes the total medical and research uses look very small. This may well happen to us, and I think it will happen.

Representative DURHAM. Is any of that being produced at all at the present time?

Dr. LIBBY. At the present time we have developed some. This is a pilot plant. We have developed some products from it. I don't believe one could say that it is being anywhere nearly as widely used as cobalt. I would like to ask Dr. Dunham to take that question.

Dr. DUNHAM. There are two sources now being used in medical research. One is at the Oak Ridge Institute of Nuclear Studies. I believe it is about 1,400 curies. Another slightly larger source is at the University of Michigan, and has just been received there. These are the first two I might call full-scale sources to be used in teletherapy.

Dr. LIBBY. I think before completing, I ought to mention that during the year we applied an 80 percent discount for all research uses of isotopes in medical fields and in agriculture. This includes therapy and diagnosis. That, I think, will be helpful.

Mr. STRAUSS. That followed a recommendation made by the Joint Committee.

Dr. LIBBY. We note with interest that the panel on the peaceful uses suggests that this extend to all research uses. We did limit it to medical uses.

Mr. FIELDS. And agriculture.

Representative COLE. What be extended to all?

Dr. LIBBY. This 80 percent subsidy on isotope cost.

Representative COLE. Yes; we discussed that yesterday.

Dr. LIBBY. Yes; we did. I think with those remarks, I have completed.

Representative COLE. Is the Commission able to meet the demand for isotopes?

Dr. LIBBY. The only type at the moment is high specific activity cobalt, and this bothers them a little because at MTR we have a pretty tight schedule. On specific activity cobalt I don't think there is any trouble.

Dr. DUNHAM. Not at the present time.

Dr. LIBBY. Cobalt which comes only from the highest flux reactors is in pretty short supply.

Representative COLE. You are able to meet the demand for isotopes?

Dr. LIBBY. The rest of it, yes, sir.

Representative COLE. Is that the same isotope which you mentioned yesterday of which perhaps the price of that isotope might be prohibitive?

Dr. LIBBY. I was referring to another case.

Representative COLE. Is it the same isotope or different?

Dr. LIBBY. No; it is a different isotope. That was a case where the cost of the isotope might have had an effect on the development of a use.

Representative DURHAM. Have you any limitations at all on the amount that is ordered by any individual, medical school or research laboratory? Do you put limitations on them at all?

Dr. LIBBY. Yes; we have health and safety regulations which have been promulgated.

Representative DURHAM. I mean limitations as to quantity.

Dr. LIBBY. We limit them on the basis of the health hazard, but not otherwise.

Representative DURHAM. Not on quantity?

Dr. LIBBY. You have to watch the quantity, because the larger the amount, the more dangerous it is. But aside from that, I don't believe there is any limitation.

Dr. DUNHAM. There is no limitation on quantity as such.

Representative DURHAM. How much are you going to spend this year on the radioisotope program?

Dr. LIBBY. I will have to ask the General Manager on that question.

Dr. DUNHAM. It is about $2 million.

Chairman ANDERSON. We had some very interesting statements from Dr. Libby. Dr. Dunham, have you anything on the medical end of it that you would like to give us?

Dr. DUNHAM. I don't think of anything special at this point. If you have any questions, I would be happy to try to answer them. We are very happy with the way the program is being picked up by universities and medical centers. Many of them are going off on their own now without a lot of actual government money, which has stimulated it. The ball is really being picked up.

Chairman ANDERSON. You feel there is substantial advancement in the use of radioactive materials in medical sciences? It is accelerating pretty rapidly?

Dr. DUNHAM. I think it is accelerating very rapidly. In fact, I know of no field of medicine right now in which isotopes are not being used somewhere. Heart disease, neurological diseases and all sorts of diseases.

Representative DURHAM. Would your comment on the brain tumor research that we are doing, Doctor?

Dr. DUNHAM. I think most of you are generally familiar with that work. It is work that was started in Brookhaven in conjunction with a group at the Massachusetts General Hospital in Boston. As the facilities at the Brookhaven pile have been improved, the prospects of this neutron-capture form of treatment for brain tumors looked better and better. As you know, and as the Committee enthusiastically endorsed, they are developing right now at Brookhaven a specific medical reactor which we believe will give them the exact tool necessary to prove out this approach to the treatment of cancer.

Representative DURHAM. That is wonderful.

Chairman ANDERSON. Thank you very much.

(Discussion off the record.)

Representative COLE. I would like to ask one question to find an answer so that I can answer the question which was asked of me. That is in connection with your next statement on manpower, with respect to training of students, and particularly foreign students.

Are the facilities at our laboratories large enough to accommodate a greater number of foreign students than we are now taking?

Mr. STRAUSS. No, sir.

Representative COLE. It is not?

Mr. STRAUSS. No, sir. For any expansion of the program beyond its present status—and that is, I think, inadequate—we would require facilities.

Representative COLE. Is the demand for training considerably greater than our ability to meet it?

Mr. STRAUSS. I would say the demand that we have and that the world has for people is greater. I don't know whether I can speak to the question as to whether the individual demand on us for facilities now exceeds our facilities.

Representative COLE. I recognize the world requirement for trained personnel is terrific.

Mr. STRAUSS. We have to stimulate applications, as a matter of fact.

Representative COLE. You have to solicit students from abroad to come over here and get this training?

Mr. STRAUSS. I did not know you were speaking entirely of foreign students.

Representative COLE. I was speaking of foreign students.

Mr. STRAUSS. No; I would not say we had to solicit foreign students, Mr. Cole, but there are countries which have bilateral agreements with us which do not have adequate talent in their own countries, and will not have until we or others have provided this training.

Representative COLE. Can you estimate comparatively whether our ability to train foreign qualified students is 50 percent of the demand, a quarter of the demand? In other words, out of every 100 foreign students who are qualified to be trained, how many are we able to accommodate?

Mr. STRAUSS. Dr. Libby has been giving this his particular attention, and I would like to have him try to answer it, if he can.

Dr. LIBBY. I expect an increased demand in the number of foreign students who would like to come would increase after 2 or 3 of the classes have gone home and spread the gospel, so to speak. I think you will see that this will rise rapidly. They may not all want to come here. It is to be hoped that the countries will install their own schools and get them organized around the research reactors and the facilities we are so anxious to help them get.

In our own domestic training program——

Representative COLE. Don't leave the foreign.

Dr. LIBBY. Yes, sir.

Representative COLE. How near are we able to handle it?

Dr. LIBBY. I would estimate that we could well use twice the training facilities we now have.

Representative COLE. Do you mean by that that for every 100 qualified foreign students that apply for training, we can take 50?

Dr. LIBBY. I would think that is not exactly true at the moment, but will be true within a year or so.

Representative COLE. What is the situation at the moment?

Dr. LIBBY. I do not know exactly how many are turned down, but my general information is that it is not a very large number.

Representative COLE. So at the present time we are able to accept and receive and train all of the students from abroad who are qualified to come over here and take the training.

Dr. LIBBY. I would say all of the students or the main majority of the students essentially all of the students—who are put up to us for training by the foreign nations.

Representative COLE. Our only injunction to the foreign government is to select persons who qualify, or do we limit them to numbers?

Dr. LIBBY. I think we limit them to three apiece.

Mr. STRAUSS. Not only do we limit them to numbers, but it is reasonable to expect that the number of bilateral agreements now in existence will be substantially increased during this calendar year, Mr. Cole.

Representative COLE. It would appear, then, that the capacity to train foreign personnel in this field is a matter of concern.

Mr. STRAUSS. Yes, it is tight.

Representative COLE. And should be given early thought and steps be taken toward providing for its expansion, looking to the future when the demand for foreign students is going to be increased.

Mr. STRAUSS. That is right, sir.

Representative COLE. Thank you.

Representative DURHAM. They are able to go to our universities, also, if they care to.

Dr. LIBBY. I was about to say, I hope this expansion will take place largely in the universities and regular colleges with our assistance. That is the direction we are taking. We have to do it on a short-range basis.

Chairman ANDERSON. Mr. Chairman, I think you have some information.

Mr. STRAUSS. Mr. Cole asked a question as to the current production of classified reports. They come at the rate of about 200 per month.

Representative COLE. What is contained in one report? You say 200 reports a month.

Mr. STRAUSS. There are about 200 reports a month that are being currently produced dealing with information that for one reason or another the originator has classified in accordance with the guide.

Representative COLE. A report, then, might conceivably contain many, many items of classified information.

Mr. STRAUSS. It could.

Representative COLE. Or conceivably it might contain only one.

Mr. STRAUSS. That is right, sir. Mr. Salisbury says they average about 40 to 100 pages each. Further information which I received at the same time this was handed to me, Mr. Cole, indicates that this backlog that I said would be furnished by the end of the month now looks as though it will be completed by the end of this week.

I think I ought to say also that this refers to classified documents believed to be useful in the peaceful program and not to the accumulation of classified papers by the Commission. The majority of those are letters and they run into the many hundreds of thousands.

Representative COLE. Thank you.

Chairman ANDERSON. If a man wanted to build a reactor, can he find enough declassified material so that starting fresh he can do it?

Mr. STRAUSS. We believe so, Senator.

Chairman ANDERSON. I think that is the important test, and I am sure that must be so. Let us go to the subject of manpower.

Mr. STRAUSS. Dr. Libby is also going to deal with that.

Chairman ANDERSON. Do you want to put the statement in?

Dr. LIBBY. I think it would be best.

Chairman ANDERSON. That will be done.

(The statement referred to is as follows:)

VIII. MANPOWER

No factor more vitally affects progress in the uses of atomic energy than the supply of skilled manpower.

Recent studies by the Bureau of Labor Statistics, the National Science Foundation, and the Commission on Human Resources and Advanced Training point to a serious, extended general shortage of trained professional scientists and engineers. This general situation is a reflection of the unprecedented demand for scientific and technical manpower coupled with the fact that the output of United States educational institutions has not kept pace with the demand and has, in fact, fallen seriously behind.

The manpower prospect in the field of reactor technology and related atomic energy matters is felt, by the Commission to be even more serious than the general condition. This disturbing outlook is due primarily to the newness of the field, combined with insufficient atomic energy equipment and training devices at the educational institutions.

To improve the outlook, the universities and colleges must have assistance in obtaining faculty training and equipment for use in teaching. The Commission is proposing to provide some such assistance. In addition, for the interim period until the educational institutions are geared up fully to meet professional manpower needs of the atomic energy industry, the Commission will help current programs by utilizing its own and contractors' personnel and equipment in short-term training activities.

CURRENT ACTIVITIES

The Commission's current activities in this field are as follows:

1. Special training schools.

The Commission operates a few special training schools. These serve Commission needs and also provide certain technical knowledge to persons outside the atomic energy program, thus filling an educational gap until such types of training can be undertaken by regular educational institutions.

(*a*) The Oak Ridge Institute of Nuclear Studies continues to offer basic and advanced courses in techniques of using radioisotopes. Four-week courses are offered approximately six times each year. Since 1948 more than 2,100 American and foreign scientists have been trained in these courses.

(*b*) The Commission sponsors the operation of two reactor technology training schools. One is the Oak Ridge School of Reactor Technology, which trains about 95 students per year. Classified data and material are used and the students must be cleared. A total of 373 students has been graduated. Through the Argonne National Laboratory the Commission operates an unclassified School of Nuclear Science and Engineering. This school is open to students sponsored by United States industry and foreign governments.

(*c*) The Argonne National Laboratory school will hold a special 2-month summer institute on nuclear engineering for engineering college faculty members during the summer of 1956. The institute will be under joint sponsorship of the National Science Foundation, the American Society for Engineering Education, Northwestern University, and the Atomic Energy Commission. Sixty students will take courses in subject matter required for teaching nuclear engineering, such as nuclear physics, nuclear engineering, separation chemistry, chemical engineering, metallurgy, and instrumentation.

2. Providing materials and services to encourage nuclear science training

Research reactors and subcritical assemblies are excellent training devices in the fields of nuclear science and engineering. A subcritical assembly consists of uranium and moderating material, such as graphite or heavy water, arranged to give some multiplication of neutrons and therefore approximating the core of

a reactor. Inasmuch as an insufficient quantity of uranium is present to initiate a self-sustaining chain reaction, the assembly cannot become critical. Therefore, unlike an operating reactor, a subcritical facility requires no control system, shielding, cooling system, etc. The assembly may be used to calculate the size of critical reactors and nuclear properties of reactor components.

To encourage the acquisition of research reactors and subcritical assemblies by nonprofit educational and medical institutions, the Commission has adopted a policy of providing certain assistance in connection with the material used in such facilities. The policy with respect to research reactors is more fully outlined in the discussion on research reactors in another section of this report. The policy for subcritical assemblies is similar to the one for research reactors.

3. Fellowship programs

The Commission sponsors a limited number of graduate fellowships to increase the supply of certain experts in the following specialized fields:

(*a*) *Radiological physics.*—The study of the effects of radiation on the human body and methods of protection. Fellows spend a full school year in university courses and 3 months at an AEC laboratory for on-the-job training. Some 261 fellows have completed the program since 1948.

(*b*) *Industrial hygiene.*—The study of the unique industrial health problems which are met in plants and laboratories using radioactive and other toxic materials. Fellows take courses at Harvard or the University of Pittsburgh and complete work for a master's degree during the academic year. Twenty-one persons have completed courses since 1952.

(*c*) *Industrial medicine.*—The study of the specialized health problems associated with the use of atomic energy in industry. These fellows, who total eight each year, may choose to study at either Harvard, Pittsburgh, Cincinnati or Rochester. Following 1 year of academic training, the fellow takes another year of in-plant work at one of the major AEC facilities. Thirty-eight physicians have been trained under this program since 1949.

4. Symposia, lectures and other special aids to education

In order to arouse interest in the atomic energy program among college and high school students and to give them some basic information on the program, the Oak Ridge Institute of Nuclear Studies and Oak Ridge National Laboratory have sponsored a series of summer, regional and special symposia.

Oak Ridge scientists also take pare in a traveling lecture program under which they visit university campuses to lecture, conduct seminars, take part in colloquia, and carry on other related activities. In addition, the Oak Ridge Institute of Nuclear Studies helped the National Science Foundation sponsor a summer institute for secondary school science teachers.

Related programs sponsored by the AEC provide various school systems with help in conducting atomic energy seminars and workshops and in displaying atomic energy exhibits.

5. Training for foreign nationals

As part of the international cooperation program, the Commission encourages the training of scientists and engineers from friendly nations. Arrangements are made for foreign scientists and engineers to visit American installations. In addition to visits, formalized programs of training may be arranged. One example is the current project to train foreign scientists in the use of radioisotopes and gamma fields.

Other training

In addition to the direct training activities which we have just described, training is also provided incident to other programs of the Commission. A considerable portion of the research activities of the Commission are carried out through contracts with universities. Some 2,000 graduate students are employed in work under these contracts and in the course of their work obtain valuable experience in the sciences related to nuclear energy. Graduate students also are employed at AEC laboratories and gain valuable experience through their use of the facilities and their participation in programs at the laboratories. Presently there are 467 such students.

AEC's laboratories also provide opportunities for university faculty members to engage in research programs. In 1955 nearly 300 faculty members were employed in the laboratories for temporary periods, performing needed research and, incidentally, gaining valuable experience with research methods and equipment. In addition, they took part in research conferences, special training programs and study groups.

Personnel from universities and private industry are gaining special experience through employment at a number of AEC installations. Such arrangements benefit the Commission by bringing to its activities some specialized talent not otherwise available. They also benefit the atomic energy industry by affording unique opportunities for practical experience not available elsewhere. These in-plant training arrangements are utilized (*a*) by universities for development of faculty members, (*b*) by newer AEC contractors for development of technical personnel to be assigned to AEC facilities, or (*c*) by other private employers for development of technical personnel for atomic energy work.

PLANNED FUTURE ACTIVITIES

The activities just described are inadequate to meet the manpower needs of the Commission and the growing atomic-energy industry. Accordingly, the Commission plans to expand its activities in this area although it recognizes that this will only partially meet the need. One phase of these expanding activities will be directed to assisting universities and colleges to obtain faculty training, special textbooks and laboratory manuals, and training devices useful in nuclear science and engineering courses. More specifically, the Commission proposes to:

(*a*) Lend training devices and laboratory equipment;

(*b*) Expand training for teaching staffs by—

(1) Supporting more summer institutes (some of these will be held specifically for high-school teachers); and

(2) Increasing the employment of university and college staff members in Commission laboratories; and

(*c*) Expand the preparation of special textbooks and laboratory manuals for use in teaching nuclear engineering subjects. It is also proposed to distribute free of charge to college libraries such valuable documents as the Reactor Engineering Handbook and other text material prepared by the Commission and its laboratories.

Another phase of these expanded activities will be directed to meeting current professional manpower needs in the atomic-energy field by—

(*a*) Expanding its fellowship programs to assist more students taking science and engineering studies related to atomic energy;

(*b*) Increasing the Commission's training courses for nuclear scientists and engineers; and

(*c*) Entering into more research contracts for engineering studies relating to reactor geometry which, incidentally, will furnish exceptional experience for those participating.

With respect to these training courses, the Commission plans to increase the number of students at the Oak Ridge School of Reactor Technology from the present 81 to 113 in September 1956. The Commission also will double the number of sessions at the Argonne National Laboratory School of Nuclear Science and Engineering by having the students take half the course at Argonne and the other half at a university. For the university training, AEC has been negotiating with both North Carolina State College and Pennsylvania State University. It is expected that the Argonne portion of this new program will last for approximately 3 to 5 years. Thereafter the Argonne school will be discontinued.

Dr. LIBBY. This, of course, is a very vital matter. I would say that technical manpower is the determining factor in our rate of progress in atomic power. It is not uranium and it is not money; it is men. This is almost a platitude but I think it is well to realize that this is so.

We have the best evidence that there is not only a shortage of people in the atomic-energy business, but in all technical fields. The causes of this is a subject we can pursue, but I think we had better perhaps spend our time thinking about particular steps the Commission is taking and planning to take about our own problems.

Our own problems are peculiar in that we have a new technology, and we have to write books and create courses, and hire teaching staffs to do this new type of instruction. I would say the new part applies mainly to the engineering instruction as contrasted with the basic

science. The basic science itself is pretty old. It began in 1896 and it grew to flower in the early thirties, and came into full bloom in the forties and fifties. But the basic science itself has been taught for years to the extent that it was known at the time. But the nuclear engineering is new.

We have to realize two things about nuclear engineering in the colleges and universities of the country. First, it is a new subject in contrast to the courses of physics and chemistry which underlie this field. Engineering courses in atomic power and atomic energy in general are new. One can teach the theory of engineering by taking the same books you take to teach the basic theory of the whole subject, but there is a difficulty in that engineers are practical people, and they have to learn to handle these things with their own hands. It is necessary to teach them by the use of actual equipment.

The second point is that the engineering schools need on their own campuses some rather specific types of nuclear equipment and apparatus which they do not now have in general. As we were saying this morning, there are only two universities at the moment which have reactors at all. Perhaps just as important as reactors in engineering instruction are the pieces of equipment which are used in the laboratory for the experimental instruction of the students.

At the Argonne Laboratory, and at Oak Ridge, we have about a quarter of a million dollars' worth of equipment each, which is used for no purpose other than for the instruction of the students. This kind of facility is needed in engineering schools. That is to say, reactors and these auxiliary pieces of equipment are necessary so that the students can learn with their hands how to build atomic reactors and to handle them.

The Commission plans to take some steps to assist in this problem of education. It is our aim to do what we can to encourage the schools and colleges to take over the task because it is not really proper that we be in the school business on any continuing basis. We should be in it as long as there is an emergency and as long as the schools are not able to carry the load right at the moment.

As we said this morning, Pennsylvania State University and the University of North Carolina are both helping us now, because they have reactors, with this third course for foreign students.

Representative DURHAM. Doctor, in your scholarship program here, you begin only at the doctor's degree level or master's degree level; is that not correct?

Dr. LIBBY. The course we have at the Argonne is essentially that type. I am not certain you could translate all of the foreign degrees into these terms, but it is essentially a postgraduate 1-year course to teach a graduate engineer or scientist nuclear engineering or atomic-power engineering. That is what it is.

You have the other problem, which is to incorporate this material into regular engineering undergraduate courses. This is being done at North Carolina and at Pennsylvania State, and we hope will be done at other schools.

Representative DURHAM. That is true. What I was thinking of is that we might go to a lower level, because if you don't start at a lower level, you never get the end results of your topmen.

Dr. LIBBY. That is right.

Representative DURHAM. That is one of the problems that you face; is it not?

Dr. LIBBY. I think it is the problem, Mr. Durham. I have been pointing out steps that the Commission is taking essentially to convert engineers to nuclear engineers. But the awful shortage of technical people which runs throughout all fields is the dominant fact. We all have to worry about it, and do what we can to correct it.

Representative DURHAM. I noticed somewhere the other day—I don't know how accurate it was—talking about the emergency, it looks like we will be in an emergency for the next 25 years unless something is done very drastically.

Dr. LIBBY. Something must be done. I think that a statement of the emergency is helpful. But we have very definite difficulties. We have an inadequacy in high school instruction in mathematics and the sciences. One can wonder and discuss what this is due to, but the fact is that there is inadequacy of instruction at the high school level.

Representative DURHAM. I guess you noticed in the New York Times last Sunday there must have been three columns advertising for engineers.

Dr. LIBBY. That is right.

Representative DURHAM. I never saw anything like that before.

Dr. LIBBY. This week's issue of the Chemical Engineering News, the trade magazine for the chemical profession, had several pages of ads for scientists. The shortage is great. Of course, the shortage itself will attract people into the field. But they cannot enter the field unless they have had the basic background that is necessary. So it is not a decision they can make on short notice.

As I said, we plan the future to lend training devices and laboratory equipment to schools.

Representative DURHAM. If we have some we are not using, we should loan it or do something with it to put it to use.

Dr. LIBBY. That is right.

Representative DURHAM. Particularly if the training facilities need it.

Dr. LIBBY. To define more clearly what I am talking about, if you build a reactor which is just subcritical you can use it for instruction on the operation of the reactor. It has not quite enough fissionable material in it to run off by itself the way a normal reactor does. By putting a neutron source in, you can watch the reaction multiply. This is one of the most valuable teaching tools. These things are expensive, because they are almost as big as a full-scale reactor. The one at the Argonne uses 5 tons of heavy water and about $30,000 worth of graphite, similar to a graphite pile. These things should be available. There are other items which are involved which are necessary for the nuclear engineering instruction.

Another step we plan is to help the teaching staffs to learn the newer material by supporting more summer institutes. Some of these will be held specifically for high school teachers, increasing the employment of university and college staff members in Commission laboratories. We plan also to expand the preparation of special texts and lab manuals for use in teaching in nuclear engineering courses and to distribute free of charge to college libraries such valuable documents as the Reactor Engineering Handbook and other materials.

We also intend to expand the fellowship program to assist more students in taking science and engineering studies relating to atomic energy.

Representative DURHAM. What is your thought there of dropping down to a lower level of help?

Dr. LIBBY. Our aim is to tend to our immediate business as much as we can, which is atomic energy, and stay pretty close to that. So we are going to have our fellowships geared to atomic energy. That doesn't mean that we are not in favor of fellowships on a broader basis, but it is not quite our business.

Representative DURHAM. I am speaking primarily to the program. I am not getting outside of the atomic energy program with fellowships. I was thinking of granting fellowships to boys who have had 2 years of good showing as a scientist. In other words, somebody who has some degree of talent of becoming a scientist.

Dr. LIBBY. Our plans have not fully solidified on this. Perhaps you can give in more detail the information on that last stage of these general fields.

Representative DURHAM. The other thing, too, at the present time, is this: Is there any thought being given to the expanding of your research programs which you initiate or which you have in the colleges of the country, which $ feel has been very helpful?

Dr. LIBBY. We are very proud of those programs. I think that they have been very helpful. We do plan to keep them going on a vigorous level, and there will be some expansion, we hope, during the next fiscal year.

Representative DURHAM. How many men would you say at the present time we are assisting in colleges with our research projects?

Dr. LIBBY. It is in the thousands?

Representative DURHAM. How many?

Dr. LIBBY. I see the number here. About 2,000 graduate students are employed in work under these various research contracts.

Representative DURHAM. That benefits the teacher, too.

Dr. LIBBY. Yes. The policy of the Government in supporting basic research in the universities has made a revolution in American science. Before this happened, it was difficult to do research in the colleges and universities for the equipment was not available. Frequently the research men had to build their own apparatus at a very large expenditure of time and energy. We see an enormous increase in the productivity of our scientific corps since World War II, and in large part this is due to the Government's policy of supporting basic research. It was not the Government's policy prior to World War II.

This, of course, helps in the instruction, because it gives the graduate students an opportunity to go to school in many instances when otherwise they could not afford it. It gives them apparatus with which to work and to learn. It keeps us on the forefront of science. It does all of the things to keep the scientific corps alive and to keep our whole technical program alive.

The only trouble is that we don't have enough customers. I think we have this bottleneck in the high schools and also perhaps some psychological bottlenecks which are not clear to me. I am quite certain that one of the most serious bottlenecks in the educational program is the matter of high-school instruction in mathematics and the

sciences. We can't do very much about that. That is out of our province. We can call attention to it, and we can help as the occasion presents itself. We can do something in the way of fellowships in nuclear engineering and helping the engineering schools get equipment and reactors and that kind of thing.

I think this is the gist and main part of this section.

Chairman ANDERSON. Fine.

Mr. STRAUSS. Mr. Chairman, with your permission, I would like to ask the General Manager to mention 2 or 3 points on health and hazards.

Chairman ANDERSON. Possibly after we have finished the industry hearings, we might arrange to have another meeting with you in which we could take up specific panel recommendations. That would give you an opportunity to again review those panel recommendations, and you can simply say on the subject of atomic propulsion, the panel surveyed certain facts, and made certain recommendations, and you can give your point of view.

Mr. STRAUSS. How soon would that be?

Chairman ANDERSON. Not earlier than 10 days and more than likely 2 weeks.

Mr. STRAUSS. We will attempt to prepare ourselves for that.

Mr. FIELDS. The next section has to do with health and safety and it has sections in it on hazards of operations, relations with the States on the regulations, and deals with the status of the question of insurance liability against third parties. These are the primary sections in the last section. I believe we covered the significant aspects of those this morning.

The only other two sections covered in this particular section of the report have to do with the status of certain research projects on waste disposal and certain research projects that are in progress on reactor safety and radiation protection measurements.

If you would like to we could go into those or insert them in the record, as you wish. I think the more significant parts of this section were covered this morning.

Chairman ANDERSON. I think they were. I think we better just insert them in the record, and let us come back to them later and check.

(The statement referred to follows:)

IX. HEALTH AND SAFETY

HAZARDS OF OPERATION

The Atomic Energy Act of 1954 charges the Commission with the responsibility of protecting the health and safety of the public with regard to the processing and use of atomic materials.

It is well established from the experience of the past 10 years in the atomic energy program that reactors and chemical processing plants can be operated safely and safe methods of handling radioactive materials have been developed. In this field where no previous experience could be called upon, the costs of achieving safety have been high.

The hazard that is dealt with is inherent in any program that makes use of the energy of nuclear fission. It results from the fact that the fission process is capable of releasing tremendous quantities of energy in extremely short periods of time, and that the byproduct materials produced by a nuclear chain reaction are highly radioactive. The new kind of hazard to people working in the plants and to the public around them rests in the possibility that exposure to radioactive materials may occur in sufficient degree to cause radiation damage to human beings, plants or animals.

In the following we analyze the methods of protection against this hazard and of assuring health and safety inside and outside the atomic energy plants. The costs of bringing this about will certainly influence the development of a private atomic energy industry. Both industry and government must be careful to avoid imposing restrictions and requirements that are not necessary to preserve health and safety. The overriding objective, however, always must be to assure public health and safety.

As the Commission attempts to develop reasonable regulations, standards, guides, and codes to protect health and safety and promote the growth of the atomic energy industry it recognizes two basic problems.

First, in order to provide a basis for designing and operating atomic energy facilities and equipment the Commission must establish the standards which will be applied in determining whether the public is being protected. Proposed standards, already discussed in detail in an earlier part of this presentation, define the permissible concentration of the several radioactive materials released or discharged from the plants; they define the allowable levels of radiation in the plant and outside it; they define criteria for disposal of radioactive waste; and they establish the need for personnel monitoring and radiation area marking. These regulations are definitive enough to enable industry to design facilities which, in operation, will meet these safety standards, as well as to enable inspectors to determine whether or not the operation meets the standards.

These standards are adequate to protect against radiation providing the facilities operate as expected. An additional step is necessary, however. This is to assure that design and operating procedures are adequate to minimize the probability of excessive exposure to radioactive materials in the event of an unexpected occurrence—human error, failure of equipment to function, and so forth.

Second, in developing an adequate regulatory program, it is necessary to provide standards, guides, and codes under which proposed design and operating procedures may be evaluated as to their adequacy in preventing accidents and in minimizing the effects of those which may nevertheless occur. Our ultimate objective is to formulate standards or codes for atomic energy equipment somewhat analogous to the codes that have been so useful in establishing safety limits for pressure vessels of various types.

The development of definitive standards or codes in this area will depend mainly on the standardization of the facilities themselves. The complex safety problems of nuclear reactors are unprecedented. At the present time, each proposed reactor is different in its major aspects from any other reactor. It is evident that the safety requirements for each reactor must be considered on an individual basis. It is possible now to develop only very general standards and guides for reactor safety.

Consequently, the initial detailed hazard evaluation must be made by the scientists and engineers who are thoroughly familiar with the specific reactor design under consideration. It is necessary that the same precise concern that characterizes the design itself be applied to the hazard evaluation.

In essence, a hazard evaluation requires a complete study of all aspects of the reactor and its operation from the viewpoint of what can possibly go wrong and what steps are being taken to prevent such an occurrence.

First, the design engineers, working with the nuclear physicist, the metallurgist, the chemist, the sanitary engineer, the meteorologist, the mechanical engineer, the electronic engineer and many other technical specialists, consider all aspects of the proposed reactor concept. They determine, either by calculation or by experimentation, what event or serious of events, no matter how improbable, could result in rapid uncontrolled increase in reactor power (also called a power excursion). In making this study, the designers determine whether the particular combination of fuel, moderator, coolant, blanket, neutron absorbers (poisons), shielding, structural material, etc., used would tend to cause the reactor to become more reactive with an increase in temperature such as would result if the reactor were to undergo a sudden power excursion. They ascertain what would be the effect on the reactivity of the reactor of a sudden removal of such items as moderator, coolant, and so forth. They show what would be the effect on reactivity of introducing more fuel, blanket or moderator material. They determine the changes in reactivity that take place as the reactor goes from initial start-up with new fuel through the various phases of operation until equilibrium conditions have been achieved. They consider the effects on the

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reactivity of subsequent start-ups with the same fuel after the reactor has been shut down for varying periods of time. In short, they attempt to predict the changes in reactivity of the reactor that take place with every conceivable event or combination of events to which the reactor might be subject.

Having done this, the designers must then show that the control and safety mechanisms which are proposed are capable of taking care of all cases under which otherwise uncontrolled increases in reactivity might occur. They must show that the electronic and mechanical systems that are to be used for control and safety are fail-safe in design, that they will act quickly enough to override the most rapid increase in reactivity that may be expected, that they are placed in such a position as to make them as safe as possible from careless or malicious tampering, that they are adequately backed up by other mechanisms in the event they fail to function properly, and that they function automatically in the event of an emergency. In determining what control and safety system should be used the designers must consider alternative methods, and must give the reasons why a particular method was selected.

The portion of the hazard evaluation which has just been described is meant to give assurance that reasonable precautions are being taken to prevent uncontrolled power excursions. The next phase of the evaluation deals with the steps which are to be taken to prevent the release of radioactive fission products from a reactor which has been shut down by the control and safety systems previously discussed.

The fission products contained in the fuel assembly of a reactor which has been operating at a high-power level continue to give off heat as a result of their radioactive decay even after the reactor is shut down. For some period of time following shutdown, this heat is sufficient to melt metallic fuel elements unless adequate cooling is maintained. Should the fuel elements melt, there are certain conditions under which the molten metal fuel could reassemble itself into a critical mass and thus cause an uncontrolled power excursion. There are other conditions under which the molten metal could react violently with air or water. In either of these cases it is possible that the majority of the fission products would be released from the reactor as gas or smoke. In any event, the fission products which are gaseous at the elevated temperatures that would occur would be released when the fuel elements melted. The evaluation should, therefore, consider what events or series of events could result in the above-mentioned condition, and it must show that adquate steps have been taken in the design to minimize the probability of such an occurrence. Generally, this means that there must be standby coolant systems with adequate secondary pumping capacity and sources of emergency power to operate this capacity.

Evaluation of the design and proposed operating procedures up to this point is concerned with determining that reasonable steps have been taken to prevent escape of radioactive fission products from the reactor core. However, it must be recognized that the only absolutely safe reactor, like the only absolutely safe airplane or automobile, is one that is not fueled. In operation, the most unlikely series of events might take place—mechanical and electrical gadetry might fail to operate as expected, human beings may make mistakes. For this reason the designers must consider that, in spite of their best efforts, an incident could occur which would result in the release of fission products from the reactor core. They must then determine what second line of defense they should contrive to minimize the consequences of even highly unlikely accidents. In making this determination, they must consider where to locate the reactor with respect to centers of population, and what type of safety structure should be used to contain the reactor.

With the growth of the atomic-energy industry there will be an increasing incentive to locate reactors reasonably near population centers, and hence the isolation principle which has been used by the Commission for all of its major reactors will probably be replaced or supplemented by a principle of safe containment. It will still be necessary, however, for a reactor designer to select his site on the basis of complete knowledge of pertinent safety factors. For instance, he must consider the hydrology, meteorology, and seismology of his alternative sites; he must look at the population density of the surrounding areas and attempt to foresee the probable population distribution in future years; he must determine whether the surrounding areas are used or will be used for industrial, commercial, agricultural, or residential purposes, or are not likely to attract human habitation; and he must know whether the surface or ground waters that might be subject to contamination by his reactor are used for human or animal consumption.

As has been stressed, a complete hazard evaluation must be made by the designers of the reactor. The experts on the Commission staff, however, working with the Advisory Committee on Reactor Safeguards, take a very active and important part in the valuation. They frequently review with the designers all phases of the evaluation. They assure themselves that the assumptions that have been used are valid. They check the key calculations. They determine whether additional experimental evidence is needed to back up the theoretical calculations that have been made. They suggest various approaches to evaluation problems. In general, they bring broad experience to bear on specific problems of evaluation.

Under its licensing function, the Commission must make the final determination that there is reasonable assurance that the health and safety of the public will not be endangered by operation of the facility. Under the inspection function the Commission must seek to assure that the facility is operated safely and in conformance with license provisions.

WASTE DISPOSAL

As civilian applications of atomic energy become widespread, more efficient means of disposing of the waste products of atomic industries must be developed.

Reactors now under development in the civilian power program do not present the same problems in the disposition of radioactive wastes as have some reactors constructed in the past. The results, in part, from provision in all these resigns for recirculation of the coolant. This makes it unnecessary to install tall stacks and extensive air-cleaning facilities as at the Brookhaven laboratory or large holding basins for the coolant water as used at Hanford. Small amounts of contamination picked up in recirculating water coolants during normal operation will be removed by continuous processing through decontamination units. The waste concentrate resulting from this decontamination process may be disposed of routinely, generally by burial in selected disposal areas. Facilities and methods for handling radioactive wastes are controlled to a considerable extent by conditions existing at the reactor site.

Low level wastes

Radioactive wastes result from all phases of the nuclear energy industry from the mining and processing of ores, through feed material processing and the fabrication of reactor cores, to the chemical processing of irradiated fuels. With the exception of those from chemical processing, however, such wastes have a relatively low level of radioactivity. Problems in the disposition of these low-level wastes are, in general, of no greater magnitude than in the disposal of those wastes from the chemical industry as a whole. Past studies have shown that under controlled conditions nature can absorb low-level wastes without harm to the public. Continuing studies are evaluating the capability of the environment to receive safely the additional volumes of low-level wastes that will become more common.

High level wastes

Chemical processing of spent reactor fuels separates unfissioned or unburned fuel from the desired product and the wastes. Generally speaking, this means separating uranium, plutonium, or other fissionable material from each other and from fission products. The troublesome fission products from an environmental standpoint are such radioactive elements as strontium, cesium, and others in the rare earth series. Because of the intense radioactivity of these elements, these wastes may contain quantities of radioactivity up to several hundred curies per gallon. In addition, these elements will remain dangerously radioactive for hundreds of years.

At present these high level wastes are stored in underground tanks at a cost ranging from $0.30 to $2.00 per gallon of tank capacity. Storage in underground tanks is not a permanent answer to the problem. In an effort to reduce costs and to find methods of permanent safe disposal, intensive development work is being carried out. One phase involves the development of special treatment system such as the fixation of radioactivity on montmorillonite clay. At the Brookhaven National Laboratory, in work now in the pilot-plant stage, it has been found that by baking the clay that has absorbed radioactivity, it is possible to fix the active material so that it cannot be leached out by water or even by strong acids. The clay can then be safely buried or stored in specially selected locations. Other safe disposal methods are being investigated at the

National Reactor Testing Station, Argonne National Laboratory, and Johns Hopkins University.

Another phase of the work that is gaining impetus at the present time involves evaluation of the capabilities of nature to receive these high-level wastes safely. An important part of this latter phase is being accomplished at the Johns Hopkins University, where members of the Sanitary Engineering Department in cooperation with such organizations as the Earth Sciences Division of the National Academy of Sciences and the Woods Hole Oceanographic Institute are developing information on the feasibility of safely disposing of radioactive wastes into the oceans or into various deep geologic structures.

Another approach is through the separation of particularly troublessome isotopes, such as cesium 137 and strontium 90, from wastes in order to simplify disposition. This approach is under study at Oak Ridge, Hanford and the Reactor Testing Station.

Up to now, waste disposal problems have been adequately met. But looking to the future, with its tremendously expanded usage of nuclear energy, it is obvious that safe and economical ultimate disposal of radioactive wastes is one of the major challenges to the industry.

Federal-State relationships

Because of their important role in other areas of public health and safety, the States are concerned with the new and complex problems growing out of private ownership and operation of nuclear facilities.

The Commission has kept the States informed of its regulatory activities in this field and intends to continue this close cooperation. For several years AEC has worked closely with the States in the health and safety aspects of isotopes distribution and use, keeping them currently informed of persons and organizations authorized to procure and use isotopes, and conducting joint field visits to users of isotopes.

We have established the practice of informing the States concerned when we receive applications for licenses to construct and operation nuclear facilities and to receive and use special nuclear material. They will be similarly informed when licenses are issued.

It is also our practice, as opportunity affords, to suggest to license applicants that they work closely with appropriate State agencies in such matters as site selection, waste disposal, and the like.

Cooperative relationships with the States have been enjoyed in the field of environmental sanitation, particularly as regards AEC installations. AEC has also worked closely with the United States Public Health Service in these matters, and in the field of industrial safety the Department of Labor has been most helpful.

Last summer, the governors of the States were invited by the AEC to designate representatives for a discussion of the AEC regulatory program. A 2-day meeting was held in July and was attended by representatives of some 39 States. The discussions at this meeting enabled AEC to obtain the views and suggestions on regulatory problems and policies of mutual interest of the State regulatory agencies represented.

As an outgrowth of this meeting, the Commission has established a 12-member advisory committee of State officials, selected from public health and labor agencies, to assist in the further revision of the proposed regulations on radiation protection. The first meeting of the committee is expected to be held in February, 1956.

There has also been continuous cooperation between AEC and local officials in connection with environmental control and waste disposal for the purpose of keeping them informed of AEC operations affecting their areas of responsibility. Among the groups involved are the Mohawk River Advisory Commission, the Columbia River Advisory Group, the Savannah River Advisory Board, the Idaho Environmental Advisory Board and the Interstate Commission on the Potomac River Basin. A number of sanitary engineers from the States and from interstate agencies have been Q cleared to facilitate the exchange of pertinent information.

Efforts have also been made to acquaint local officials with the environmental problems of waste disposal through individual contact and by means of meetings such as the Sanitary Engineering Conference held in November 1955, at Cincinnati, Ohio. This meeting was sponsored jointly by the United States Public Health Service and the AEC.

The relationship between the AEC's regulatory controls to protect health and safety under the Atomic Energy Act and the Authority of the States has been given extensive consideration by the Commission.

The subject involves a variety of questions. Questions frequently asked are whether Congress has "occupied" or "preempted" the field of health and safety regulation with respect to the possession, use, disposal, etc., of source, byproduct and special nuclear material; whether the States may validly impose additional requirements on Commission licensees; whether the States may validly impose regulatory requirements in areas subject to AEC's regulatory jurisdiction but as to which the Commission has not yet issued specific requirements; the extent to which State controls over the contamination of waters and streams, electrical codes, zoning ordnances, etc., may be applied to Commission licensees. This list of questions is not exhaustive.

These and other questions involved are interrelated in varying degrees and depend to a substantial extent on the precise factual circumstances in which they may arise. Moreover, although there is a considerable body of judicial decisions which consider similar kinds of questions in a variety of situations, none of the decisions involves the Atomic Energy Act.

Although we do not believe that clear-cut answers can be given at this time to many of the difficult questions which are involved, we can provide answers to some specific questions as they arise. We have informed inquirers that AEC's regulatory controls are designed to protect against hazards of radiation and other hazards associated with the radioactive nature of the materials involved. Thus, for example, we do not regard our regulatory controls over the fabrication of special nuclear material as relieving the fabricator of any obligations he may have under State law to equip his machine tools with safety devices or to provide fire escapes. As the program develops, a great many such questions will arise to which we will be able to provide specific and clear answers and we will do so.

Since it is clearly a responsibility of the AEC under the 1954 Act to regulate the processing and utilization of source, byproduct and special nuclear material to protect health and safety of the public, we have prepared and issued regulations for that purpose. We believe that all persons subject to the regulations are legally required to comply, and laws of the State cannot relieve them from compliance.

We recognize, however, the very important interests of the States in the subject matter, particularly in view of the fact that many sources of radiation hazards are not subject to the AEC's regulatory jurisdiction. Accordingly, we have endeavored to consult with the States and to keep them advised with respect to the Commission's regulatory activities. We hope that close cooperation among the States, industry and the Federal Government will avoid the imposition on industry of diverse or inconsistent requirements.

INSURANCE

Nature and extent of the risks

Another factor of great importance and interest to the private atomic energy industry is that of insurance protection in the operation of nuclear facilities. The risks involving damage or injury at the site of the facility appear to be of the type normally covered by the insurance industry. The primary problem, however, arises from the fact that there exists a remote possibility of a catastrophe which could be substantially more serious than any visualized in other types of industrial operations.

That this potential is remote is illustrated by the fact that the Commission's reactor operations recently reached the sizable total of 700,000 hours of reactor operation without occurrence of any serious accidents. Under comparable conditions there would be, therefore, only a small probability of very extensive claims for damage against reactor operators, the manufacturers of reactor equipment and their insurers. This experience record, the research and development work underway by Commissions' laboratories and other organizations, and the rigorous review of hazard problems in connection with the licensing of atomic energy facilities as described earlier, all support the conclusion as to the remoteness of the possibility of serious accidents.

Nevertheless, the remote possibility of a catastrophe is still present, and it creates a particularly serious risk problem with regard to public liability. Injury to persons apd damage to property away from the site occasionally have been very large in other types of industrial operations. Adequate insurance coverage has been available for such facilities and the possibility of large losses has not prevented their construction and operation. The nature of the problems in the nuclear field, however, differs markedly from those with which industry has had experience because large-scale radioactive contamination presents new and unfamiliar hazards.

The necessity for liability insurance

The availability of insurance covering atomic energy installations became a matter of imediate interest only after the passage of the Atomic Energy Act of 1954. Up to that time the atomic energy program in the United States was financed wholly from public funds, and the Government assumed directly all risk of loss. Private insurers, accordingly, had only a limited knowledge of the hazards related to atomic energy activities, no basis upon which to evaluate those hazards, and no need to develop and make available private coverage in the field. Prior to the 1954 act, private insurers had confined their interest largely to workmen's compensation insurance and to hazard survey studies related to the shipment, storage, and handling of radioisotopes and the design, installation, and operation of cyclotrons and particle accelerators.

The Atomic Energy Act of 1954, in permitting the private ownership and commercial operation of nuclear reactors and the distribution of reactor fuels under license, contains a requirement that "the licensee will hold the United States and the Commission harmless from any damages resulting from the use or possession of special nuclear material by the licensee." In effect, this provision places the burden of liability for damages resulting from private atomic energy activities on the private entrepeneurs.

Because of the enormous potential of the hazard involved, the several segments of the atomic energy industry immediately pointed to the necessity for spreading the risk of liability through insurance. The matter was and is of real interest not only to future owners and operators of reactors, but, under prevailing legal doctrine, also to manufacturers and suppliers of reactor parts and those responsible for design, construction and installation of reactors and related facilities. The unavailability of atomic energy insurance was held to be an impediment since, it was argued, prudent management would hesitate to enter a field which would put at risk the whole of corporate assets. The prevalent attitude in this regard formed the basis for the Commission's statement to the joint committee at last year's section 202 hearings that the lack of insurance consituted a possible deterrent to industrial participation and the suggestion that if the size and nature of the risks proved too difficult for private insurors, the Commission might ask Congress to consider appropriate legislation. At the same hearings, representatives of industry asked Congress to review the problem; and only one company, Consolidated Edison, announced plans to construct and operate a reactor with the insurance question unanswered.

Insurance study group

In March 1954, at the request of the insurance industry, the Commission cleared 10 insurance executives representing casualty, liability, surety, and fire and explosion interests from leading capital stock and mutual companies to carry out the following studies:

(*a*) To review insurance problems created by expanded industrial participation in atomic energy;

(*b*) To develop information and criteria with respect to the insurability of industrial atomic energy installations and undertakings; and

(*c*) To make appropriate recommendations to the Commission, including any specific legislation needed.

In June 1955, the insurance study group submitted an interim report listing five types of coverage involved in insuring atomic energy activities and stating general conclusions with respect to each type, summarized as follows:

(*a*) Reactor plant insurance: "The insurance capacity for the physical hazards as now applicable to more hazardous types of chemical operations appears to be adequate to cover atomic reactor plants."

(*b*) Reactor and machinery insurance: "Physical damage losses to reactors and machinery * * * can probably be handled in the same way that boiler and machinery coverage on extrahazardous machinery is now handled in other industries." However, coverage for damage resulting from radioactive contamination of machinery and equipment "presents new hazards requiring further investigation by the insurance industry to determine the nature and scope of coverage that can be afforded."

(*c*) Loss of use insurance: This "presents a difficult insurance problem during the period of early development of industrial atomic power. * * * If any such protection is available it will be somewhat limited in amount."

(*d*) Workmen's compensation insurance: "The workmen's compensation hazard * * * can be handled by existing insurance facilities."

(*c*) Public liability insurance: "The public liability hazards resulting from damage to persons or property * * * can be insured by existing insurance facilities up to the limits of liability normally available to more haazardous types of industrial enterprises." However, the field of third-party liability presents "the most serious problem as to the amount of insurance available" as a result of "the very high aggregate dollar amount of claims which might arise in the event of a possible, though not necessarily probable, catastrophic accident."

In addition to these conclusions, the study group (a) noted that, "the catastrophe potential, although remote, is more serious than anythingn now known in industry", and (b) declined, as not properly its function, "to determine whether or not legislation should be proposed under which the Government might assume liabilities in excess of those" covered by private insurance.

Views of industry on study group report

Subsequent to the date of the interim report, the Division of Civilian Application requested comments from interested industrial concerns with respect to the group's general conclusions. Seven responses were received.

The general view expressed in the comments received was to the effect that while it was probable that adequate insurance would be available for other types of risks, the conclusions did not provide assurance that adequate coverage in the field of third-party liability would be made available. Members of the atomic energy industry have steadily maintained this position; thus, for example, a representative of the equipment manufacturers, speaking before the annual meeting of the American Bar Association in August 1955, stated with reference to the study group report that it now appears unlikely that the private insurance industry will ever be able to assume the full risk of atomic accidents. Similarly, the vice president and general manager of the atomic products division, General Electric Co., speaking before the Atomic Industrial Forum in September 1955, advanced the position that, in spite of the study group's report, insurance still represents a significant roadblock in America's progress in the power-reactor field.

Liability insurance pool

Since the date of their interim report, the members of the study group have translated their general conclusions into specific amounts of insurance. This has necessitated the formation of pool arrangements of both the capital stock casualty companies and the mutual companies and the formation of an underwriting syndicate.

At a meeting of the insurance study group held on January 31, 1956, it was reported that with respect to third-party liability the syndicate of stock companies will be ready to provide $50 million coverage for each insured project and that the mutual companies will be prepared to provide coverage in the amount of $10 million.

This amount of coverage is more than double the amount of coverage written in any known single instance in the history of liability insurance. In spite of this, however, the indications are that this amount will not be deemed adequate by the atomic energy industry to cover the "conceivable catastrophe." At recent meetings of industry advisory groups with the Division of Civilian Application, the majority view expressed was to the effect that nothing short of complete protection of corporate assets would be deemed adequate.

Concluding comment

Any consideration of a position with respect to Government excess-coverage insurance must proceed from certain basic premises:

(*a*) The amount of liability coverage to be made available by private insurers will be unprecedented in amount.

(*b*) The expressed desire of the atomic energy industry to be protected to the extent of corporate assets on an open-ended basis places the problem out of the context of insurance as generally applied in other fields, where some measures of calculated risk are taken in connection with maximum conceivable losses.

(*c*) There is at present no sound basis upon which industry can estimate the extent of its insurance needs, due to lack of operating experience to form the basis for both the probabilities of an accident and an estimate of the extent of damage.

If it is determined that protection in excess of that available from private insurers is needed (in the sense that the lack of excess coverage constitutes a

deterrent to full industrial participation), several important problems will remain:

(*a*) What type of Government assistance is most desirable? The choice here seems limited to three forms of assistance: direct Government excess-coverage insurance, general indemnity, or limitation of liability combined with public protection through a disaster-insurance plan.

(*b*) If excess-coverage insurance seems desirable, what basis will be used in determining the rates to be charged? To date, no definitive rate studies have been undertaken by the private insurers, and the indications are that initially each project will be evaluated separately with respect to the cost of coverage.

(*c*) Should there be an upper limit on the amount of Government assistance provided and if so what factors are available for consideration in setting the limit?

Need for legislation

The Commission is giving continuous attention to the various aspects of this important problem but has not yet reached a conclusion as to whether Government insurance will be needed.

RESEARCH IN REACTOR SAFETY AND RADIATION PROTECTION

Reactor safety

During 1955, a series of tests was initiated to determine the safe operating limits of reactors of various classes and to investigate the mechanisms that contribute to inherent reactor safety. Data on heterogeneous reactors is being developed as part of the special power excursion reactor tests (SPERT) by the Phillips Petroleum Co. at the National Reactor Testing Station in Idaho. Power transient tests on small homogeneous reactors, kinetic experiments on water boiler reactors (KEWB) are being conducted by North American Aviation, Inc., at Santa Susana, Calif.

Reactor safety experiments which can be carried out without the use of a nuclear reactor are termed out-of-pile tests. Out-of-pile tests are now being carried on as follows:

North American Aviation, Inc., is conducting a fuse development program in order to design simple safety mechanisms which can be built into a reactor to protect it against power surges.

The Aerojet General Corp. is measuring the energy release of the possible reaction of melted fuel elements with reactor cooling water, and is searching for inhibitors of this reaction.

The naval ordnance laboratory and the Aberdeen Proving Grounds of the Army are evaluating the resistance to possible reactor power excursions of reactor pressure vessels and large overall reactor containers in order to determine the best design for these structures.

The Argonne National Laboratory is studying the conditions under which reactor fuels and structural materials such as uranium, plutonium, and zirconium burn in air, in order to develop safe handling procedures which will prevent them from igniting.

With the increasing spread of atomic energy activities into civilian pursuits, radiation protection assumes increasing importance and complexity. When atomic industry was confined to a few large contractors, the radiation protection problem encompassed only a relatively few workers under the watchful eyes of highly competent and experienced health physicists. Very little byproduct radioactivity was allowed to escape to the environment, and populations as a whole were subjected to little or no exposure from such sources. As the number of atomic energy plants and workers increases, however, protection of the environment and of populations becomes a more difficult problem, not only because the radioactivity per person increases, but because economic pressure for lower costs becomes greater.

Absolute shielding of radioactivity would be possible only at infinite cost. For atomic energy to be economically feasible, there must be a balance between the cost of protection and the exposure that the populace may be asked to accept with due regard for public health and safety. In order that such a balance may be realistic, it becomes even more necessary than heretofore to know the hazards which stray radioactivity might produce, such as possible tumor production, blood disorders, genetic hazards, life shortening, and general debility. There is no doubt that radioactivity in sufficient quantity will cause such damage. But we do not have in as precise a form as we should like to have at the present time exact knowledge as to just how small an amount of radioactivity will initiate

any of these biological phenomena. On the other hand, we do have data which are sufficient to enable us to establish health and safety regulations which we believe are reasonable and adequate.

The National Committee on Radiation Protection, a body of experts whose work is sponsored by the National Bureau of Standards, has recommended maximum permissible limits for various kinds of exposure to radioactivity. These limits are considered safe on the basis of present knowledge. Because of factors entering into the exposure of large numbers of persons of various ages and varying physical condition, the committee has recommended that the exposure limits for the general population not exceed one-tenth of the maximum exposures permissible for atomic industry workers. Radiation safety standards in Commission facilities are based on the committee's recommendations, as are the standards for Commission licensees set forth in proposed health and safety regulations which have been published by the Commission.

While it is to be expected that reactors themselves will produce negligible activity in the environment, processing of the original and spent fissionable material is potentially a source of exposure to workers and the general populace. Mine gases, milling dusts, and metallurgical processes may expose the workers. In the processing of spent fuel, radioactive iodine may pass into the air and deposit on vegetation, whence it will be picked up by animals and human beings. Ruthenium particularly may pass up the stacks and be similarly deposited. Strontium, cesium, and barium may constitute the most hazardous of the other fission products in that, if they are released as wastes to the air and streams of the environment, or consigned to the earth or sea in an inadequate manner, they may find their way into the food and drinking water supplies. Fission products in general, if given improper waste handling, might also reconcentrate in such a way as to produce excessive external radiation doses. Plutonium, uranium, and possibly thorium must be reprocessed into fuel elements, giving rise to potential hazards to the workers.

All these possibilities require that we understand the hazards involved in order that they may be dealt with adequately. To this end, the AEC is supporting much research which will contribute to the determination of permissible exposure. As examples, there are studies on:

1. Tumor production in dogs by plutonium and radium (University of Utah) and by strontium (Argonne Laboratory and planned for University of California at Davis); similar studies on rats and mice at Argonne.

2. Decrease of life span by X-rays on rats at University of Rochester; by gamma rays on burros at Oak Ridge Institute of Nuclear Studies; X-rays on dogs at California; planned for strontium on dogs at California; plutonium, radium, polonium, and strontium on mice at Argonne; radon and other alpha emitters at Rochester.

3. Lung retention of alpha emitters particularly, but also of beta emitters and fission product particles at Rochester, New York University, University of Pittsburgh, University of California at Los Angeles.

4. Genetic effects of low level X-rays on drosophila at Brookhaven and on mice at Oak Ridge National Laboratory; genetic studies of human beings who were exposed to radiation in Hiroshima and Nagasaki, conducted in Japan and at the University of Michigan.

5. Effects of low level chronic X-irradiation on the fertility of dogs at Rochester.

Concurrently with the above studies the AEC medical research program is continually searching for practical means for dominishing radiation effects in humans such as has been repeatedly demonstrated as possible in experimental animals. Further, efforts are being made to develop specific substances which would be useful in treating and, perhaps, in correcting radiation injury once it has occurred, as does whole bone marrow and embryo spleen brei in mice.

Chairman ANDERSON. I would like to suggest as in connection with the panel report, it would be appreciated by me if we could have a continuing report on your plans to meet with State groups and try to work out this problem. I am afraid that there is going to be an effort or suggestion, at least, that maybe we ought to have some legislation that tries to mark the boundaries of where Federal supervision stops, and State supervision starts. It seems to me to be an unfortunate thing if we came too quickly to that point. Maybe it is something

that ought to be explored pretty well between your organization and the various State health and safety groups.

Therefore, if we could insert this in the report and have you prepare for us at some subsequent time a discussion on the practical ways in which we are going about trying to bring together an understanding between the States and the Atomic Energy Commission, that would be most valuable to them and most valuable to us.

Mr. FIELDS. We would be happy to do this.

Then the remaining section, sir, is on patents.

Chairman ANDERSON. That could almost be read. That is not very long. Or it could be commented on, whichever way you wish.

Mr. FIELDS. I will ask the General Counsel to take that.

Mr. MITCHELL. I think probably, Mr. Chairman, we might place this in the record, and I can summarize some of the high points, and then if you have any questions, we can go into more detail.

Chairman ANDERSON. That is fine. We will do it that way.

(The report referred to follows:)

X. PATENTS

With the limited experience so far available under the patent provisions of the 1954 act, it is not possible to assess the effects of these provisions on industry. The following sums up the position on patents as it exists at the present time:

Section 152

As of February 1, 1956, 30 applications have been reported to the AEC by the Commissioner of Patents in accordance with section 152. The Commission has filed no directive under the provisions of section 152 to have any of the patents issued to the Commission. In certain of these cases the rights had previously been determined between the applicant and the Commission in accordance with a contract. In the remaining cases, it was unnecessary to consider whether a directive should be issued since there was no evidence of a contract or other relationship within the meaning of section 152. The limited number of cases reported by the Commissioner of Patents up to this time is due in part to the fact that most of the inventions arising under contracts and subcontracts have been the subject of patent applications filed by the Commission. Any marked increase in the reportable patent applications resulting from increased private industrial activity in atomic energy under section 152 by the Commissioner of Patents is not expected until some time in 1957, since the normal prosecution time in the United States Patent Office is something over 3 years.

The Commission has waived such rights with respect to any invention or discovery as it may have pursuant to section 152 of the act by reason of the invention or discovery having been made or conceived as a result of access to restricted data under an access permit. Prior to adoption of the access permit program, the dissemination of restricted data outside the Commission's own program was severely limited; and the Commission's patent policy was designed to minimize the competitive advantages which might be obtained through receipt of restricted data. Under the access permit regulation, however, restricted data relating to the peaceful uses of atomic energy is (subject to certain security restrictions) made generally available to American industry. In view of the widespread dissemination of such restricted data now permitted by the regulation, and in order to stimulate research and development in the atomic energy field, it was felt that the mere fact that an invention or discovery resulting from access to restricted data should not disqualify the inventor from obtaining patent rights.

As the access regulation was originally published, the Commission reserved a royalty-free, nonexclusive license for governmental purposes, in inventions and discoveries resulting from access to secret restricted data obtained under an access permit. Upon reconsideration of the proposed rule, it was concluded that the reservation of the license for governmental purposes should not be retained. The license applied only to uses for Government purposes and not to private commercial activities where the preferred position problem has its greatest potential impact.

As a condition for receiving access to restricted data, the regulation requires access permittees to waive any claim for damages resulting from the issuance of a secrecy order against any classified inventions and for damages under section 173 of the 1954 act.

In addition, as the Commission announced in the hearing last year, the mere fact of a license is not considered to subject the invention to section 152. It is intended to publish in the Federal Register shortly the General Counsel's opinion to this effect.

Section 153—Compulsory licensing

The Commission has not invoked compulsory licensing, nor has any compulsory licensing proceeding been initiated by any private party. The few issued patents in the atomic energy field, not arising out of Commission-sponsored work, do not provide a sufficient basis to evaluate the role of compulsory licensing in the atomic energy industry. The Commission published on January 27, 1956, in the Federal Register rules setting forth the criteria for the issuance of licenses and the conditions applicable to compulsory licenses. The proposed rules of practice to govern such proceedings were also published in the Federal Register on the same date.

Filing of foreign patents

With regard to the filing of foreign patent applications, it should be recognized that the cosiderations depend on whether the subject matter involves restricted data and whether it results from a contract with the Commission. Where an unclassified invention does not arise out of a contract or subcontract with the Commission, there are no AEC restrictions on the owner filing outside the United States. Where an unclassified invention arises out of a contract with the Commission, the Commission either undertakes to file for a foreign patent itself or encourages the contractor to file for such patent with the respective rights between the Commission and the contractor being governed by the contract.

In the case of inventions or discoveries involving restricted data, foreign patent applications can only be filed where the data involved falls within the scope of the data exchangeable pursuant to an agreement of cooperation. Where the subject matter of the foreign patent application falls within the scope of an agreement for cooperation, a foreign patent application may be filed under the appropriate security safeguards. The Commission maintains a periodic check of all patent applications under secrecy orders, and in the last 6 months 129 secrecy orders have been rescinded.

Rules and regulations

The rules under section 156 covering the granting of patent licenses on Commission-owned inventions and on patents declared affected with the public interest were published in the Federal Register on January 27, 1956. In addition, rules of practice governing such proceedings were published in the Federal Register on the same date. The Commission has granted some 498 licenses on a portfolio of 845 patents that have been issued and are owned by the Commission.

The revised rules governing Patent Compensation Board proceedings under section 157 and section 173 were published in the Federal Register on June 7, 1955. The principal revisions are a section providing for interrogatories in connections with the proceedings in order to simplify the hearings and one providing for motion before the Patent Compensation Board. The revised rules continued the previous provision that the action of the Board is the final action of the Commission which is subject to judicial review in the courts under section 189.

Mr. MITCHELL. Generally speaking, we have not yet had enough experience under the act of 1954, to assess the effects of the patent provisions on industry. Therefore, about all we can do at the moment is to report to you on some of the things that have been happening to date. With respect to reports which are required to be made to the Commission by the Commissioner of Patents under section 152 there have been 30 applications that have been referred to us since the new law went into effect, and we have not found it necessary to assert any rights against the Commissioner on any of them.

Representative DURHAM. In other words, they could proceed and get their patents.

Mr. MITCHELL. The situation has been either that we already had arrived at an understanding with the applicant under our contract provisions, or else the application itself made it clear that there were no contract provisions involved. Therefore, it was not necessary for us to assert any rights.

Representative DURHAM. Have you had any foreign requests for applications?

Mr. MITCHELL. Section 152, Mr. Durham, applies only to applications made in the United States Patent Office. As to the foreign situation, this is the case. With respect to unclassified inventions and discoveries, if we have no contract or subcontract rights, then of course the owner is free to make whatever foreign filings he likes. If we do have contract or subcontract rights, then we make a determination first as to whether we wish to file in a foreign country on behalf of our Government. If we do not, we notify the owner to that effect, and he then has an opportunity to file in his own name if he chooses to do so.

In either event, of course, whatever contract arrangements we have would apply to the rights that issue under the foreign patent.

In the classified area, obviously no patent application can be filed abroad, unless the subject matter is covered by a bilateral agreement which includes classified topics. If there is a bilateral agreement which covers classified topics, and the invention or discovery falls within it, then we go through the same process that we would in the unclassified area. We would determine first whether we wished to file abroad, and if we do not, then we give the owner an opportunity to do so.

Mr. Price mentioned this morning that the Commission waived its rights under section 152 with respect to access permits. The Commission has also taken the position which we understand to be in accordance with the intent of Congress, that a mere license, with nothing else, does not constitute an arrangement or relationship within the meaning of section 152, and therefore we do not assert any rights there.

With respect to compulsory licensing, we have not yet found it necessary to assert any rights or bring any proceedings under those sections. We have enlarged the rules of practice of the Patent Compensation Board to include this area should it be necessary in the future to bring any such proceedings.

We have published rules under section 156 with respect to granting of patent licenses on the patents owned by the government, and also procedures with respect, as I say, to proceedings under compulsory licensing sections. Those were publisehd in the FEDERAL REGISTER of January 27 of this year.

I think those are the main points, Mr. Chairman.

Chairman ANDERSON. Thank you. That concludes the hearing, and I want to say, Mr. Chairman and members of the Atomic Energy Commission, and members of your staff, that it is a matter of great pleasure to me to have these concluded rapidly, and I hope successfully, but most of all harmoniously. Fortunately, at this time we have not had a single word on what was at one time a diversified subject, and it has helped us to get through promptly. I appreciate the care that has gone into the preparation of these documents. We will analyze them. Most of those documents can be handled by correspond-

ence, merely submitting to the Commission questions that may have arisen in our minds, and obtaining from you comments which can be circulated to the members and then at some time made a part of the record.

I regret the attendance on the part of the committee has not been better, but this is a very busy 2 or 3 days, with people trying to get away. I think maybe at some future year another chairman will schedule them at a better date. I had not realized the situation on the Lincoln's Day holiday. I am glad that we have concluded them and concluded them, as I say, with good wishes all the way around. I think that is worthwhile.

Mr. STRAUSS. Mr. Chairman, on behalf of my colleagues and the staff of the Commission, I would like to have the record reflect and reciprocate those sentiments.

Chairman ANDERSON. Thank you.

(Thereupon, at 4:45 p. m., Wednesday, February 8, 1956, the hearing was recessed until Wednesday, February 15, 1956.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

WEDNESDAY, FEBRUARY 15, 1956

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 10 a. m., pursuant to call, in room F–82, the Capitol, Senator Clinton P. Anderson (chairman of the Joint Committee) presiding.

Present: Senator Anderson, and Representatives Price, Cole, Hinshaw, and Dempsey.

Chairman ANDERSON. The committee will be in order.

This morning we are opening the second phase of the hearings which the Joint Committee on Atomic Energy is required to hold during the first 60 days of each Congress to receive, and I now quote section 202 of Public Law 703, "information concerning the development, growth, and state of the Atomic Engery Industry."

Last week the committee received a detailed report from the Atomic Energy Commission on what it had accomplished during the past year in implementing the provisions of the Atomic Energy Act of 1954 which was written with a view toward encouraging and accelerating the peaceful applications of atomic energy.

Today we start a series of hearings during which we hope that anyone in industry or the public at large could give us the benefit of any experience they may have had during the past 12 months with these provisions of law, and with the regulations and administration thereof by the AEC.

When the committee undertook the revision of the Atomic Energy Act of 1946 almost 2 years ago, it had every reason to believe that the time to initiate a large and dynamic program of putting the peaceful atom to work for the benefit of mankind was at hand.

Lending a sympathetic ear to the insistent urging of many people from all segments of our economy, the committee redrafted the Atomic Energy Act of 1946, in such a way as to facilitate, in our judgment, such a program.

One provision was section 202, which makes it mandatory that the committee hold hearings during the first 60 days of each Congress "for the purpose of receiving information concerning the development, growth and state of the atomic energy industry" was felt to be particularly necessary and desirable.

By this means the committee felt that everyone affected by the new provisions of the Atomic Energy Act of 1954 would be assured of a chance to be heard once each year.

Further, if after 12 months experience with the provisions of law or the administration thereof there should be an indication that there are undue restrictions which are holding back the rapid and large scale use of the peaceful atom, the committee by these hearings could be officially apprised thereof.

Last year we heard from many witnesses from many industries, associations and professional organizations. They discussed what they sincerely believed to be many basic and difficult problems.

Twelve months later, with no changes in the law, I find, upon glancing over the list of witnesses who have availed themselves of this opportunity, that the number is few.

Whatever the implications of this may be, we are here and ready to proceed now.

I want to welcome our witnesses, the first of whom is Mr. Clyde T. Ellis, manager of the National Rural Electric Cooperatives.

I do want to say just this morning I have heard again from Mr. John Jay Hopkins, who is head of a committee for the National Association of Manufacturers. He sent me a telegram and sent me a message that he wanted to appear, he wanted to testify, but was not yet ready to do so. We are not going to foreclose people because of the time schedule. Some of the well-known manufacturing concerns who are greatly interested in this problem have asked me if they could have a little longer time for their preparation. Naturally I am most happy to grant that to them. I do want to point out that generally speaking it ought to become known after a while that every year this opportunity will be afforded, and Members of the Congress don't need to be reminded that we have to be on duty on January 3. We know that every year the Congress reconvenes on that date. I hope that industry and the Atomic Energy Commission and others generally will come more and more to depend on the holding of hearings and will spend some of the intervening time getting ready for them.

Also, this year the Atomic Energy Commission is going to come back at a subsequent date for specific comments on some of the recommendations made in the panel report, the so-called McKinney report. We have asked them to take the various sections of the report where it says, "We recommend the following", and go through those recommendations, and let us have the benefit of their advice and counsel on it. Subsequently, some members of industry have said that they would like to comment on the recommendations. That, of course, is going to be possible also. I am merely trying to say that we are not going to hold today and tomorrow some hearings, and then say forever everybody is deprived of an opportunity to be here and testify.

Representative COLE. Mr. Chairman, may I express my own hope that it will not be the Chairman's intention of prolonging these hearings, however. The individuals whom you have named as expressing a desire to be heard, but are not quite ready, are all organizations who are familiar with the law. They know that this provision was written into the law at their request and for their benefit. Why they should wait until toward the end of the 60 days, and then say they are not prepared to present whatever comment they want to make with respect to the law is beyond me. While I am ready to hear all their grievances or all their comments, 60 days is a long enough period of time. All of us on this Capitol Hill are busy with many, many things. Certainly we are fully as busy as those people who are now asking

for more time. I do hope by the end of the 60 days or by the end of this month, their presentation will have been made so that we can get on with other things.

Chairman ANDERSON. I could not agree with you more. I only say, Mr. Cole, because your name was on the bill, I think it was a very fine provision in the bill, but that there seemed to be some unusual circumstances.

The National Association of Manufacturers has set up a special committee. Mr. Hopkins was made chairman of it. That was only done in the last few days. He was forced to be abroad. Under the circumstances, I felt that I didn't want to say to him, "the fact you are going abroad precludes you from an opportunity." I echo what you say. I think that the industry and the general public ought to know that these first 60 days are available for this sort of hearing and that in the future, whether they get a notice or don't get a notice, that the day for their opportunity to present their point of view is here, and they don't need to be specially invited.

Mr. Ellis.

STATEMENT OF CLYDE T. ELLIS, GENERAL MANAGER, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION, ACCOMPANIED BY CLAY L. COCHRAN, STAFF ECONOMIST, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

Mr. ELLIS. My name is Clyde T. Ellis. I am general manager of the National Rural Electric Cooperative Association. NRECA is the national service organization representing 91 percent of the operating rural electric systems in the United States (including Alaska). These systems serve about 3,722,000 farm families and rural establishments.

I appreciate the opportunity afforded by the Atomic Energy Act of 1954 to appear before the committee each year and tell you about the progress we are making in the field of atomic power and also to request your assistance on some of the difficult problems we are encountering.

Once again I am appearing before this committee fresh from our national annual meeting which was held this year in St. Louis, from January 23 through January 26. This meeting was attended by over 5,000 managers, directors, and employees of the rural electric systems. Prior to the meeting various committees of the members considered our problems and recommended resolutions to the full meeting for their consideration. These resolutions were all cleared through the national resolutions committee and were available for all delegates to study at least 24 hours prior to the time they were acted on. All of the members of our 10 committees are elected from the grassroots, from each of our 10 regions, to serve, 1 on each of the committees. Attached are copies of the atomic power resolutions which were unanimously adopted by the membership. I shall refer to them later.

Our interest in atomic power continues at a high pitch. There are many examples of our increased activity in this field. Our atomic energy study group received final approval from the AEC on March 18, 1955. Although our study group has been hampered by a lack of adequate staff and funds, we have made some progress in looking

into developments in the atomic power field. There have been several meetings of the full study group with officials of the Nuclear Power Branch of the Army Corps of Engineers, the AEC, and private industry who discussed the work they are doing in the development of power reactors. Also, members of the group made visits to various AEC installations such as Oak Ridge, Argonne, Arco and Shippingport, Pa. We feel that the activities of the study group have been responsible for bringing to the attention of the rural electric systems some of the new developments in this rapidly changing field, and also have been responsible to a great extent for the proposals which have been responsible to a great extent for the proposals which were received from the rural electric systems by the AEC under their small-scale demonstration power reactor program, the deadline of which was February 1. The study group held a special meeting in Chicago in the middle of November in an effort to acquaint all the interested rural electric systems with this new AEC program.

The three proposals submitted by rural electric cooperatives under AEC's small-scale program are evidence that the rural electric systems are tremendously interested in atomic power. These three cooperatives are:

1. Rural Cooperative Power Association, a federated generation and transmission cooperative of Elk River, Minn., which submitted a proposal for a 22,000-kilowatt boiling water reactor.

2. The Wolverine Electric Cooperative, a federated generation and transmission cooperative of Big Rapids, Mich., which submitted a proposal for a 10,000-kilowatt aqueous homogeneous reactor.

3. Chugach Electric Association, Inc., a distribution cooperative of Anchorage, Alaska, which submitted a proposal for a 10,000-kilowatt sodium-cooled, heavy water moderated reactor.

These rural electric cooperatives are in some of our highest cost power areas. In 1954, the wholesale delivered cost of power from the Chugach Electric Association was 19.4 mills.

Chairman ANDERSON. Do they get any power from the new project in Alaska?

Mr. ELLIS. The Eklutna? Yes, but the amount they get is wholly inadequate, and they have to generate a substantial part of their own.

From the Rural Cooperative Power Association the cost ranged from 8.4 to 18.2 mills, while for the Wolverine Electric Cooperative the cost ranged from 5.6 to 14 mills. These high power costs, of course, account in large part for the keen interest of our systems in atomic power. It should be pointed out that none of these proposals has yet been accepted by the AEC as an acceptable basis for negotiation of a contract. The AEC must make many basic policy decisions regarding cooperative participation before any contracts can be negotiated.

Representative HINSHAW. I am curious to know what power cost you expect to get from atomic energy at these installations and whether they are within the range of the thing you are talking about, for the amounts of electricity that are to be furnished.

Mr. ELLIS. Yes, Mr. Hinshaw, we hope to get the cost considerably under the present cost, and under conventional costs.

Representative HINSHAW. Under these costs you have stated here?

Mr. ELLIS. Yes.

Representative HINSHAW. I have not heard of any generation of that quantity of electric power that could be within that range of cost.

Mr. ELLIS. We have such faith in the program and the possibilities that we believe that with proper cooperation as between AEC and the rural electric systems and REA it may be possible to get the cost not only below these costs, but below any conventional costs that might be obtained.

Representative HINSHAW. May I ask how that is proposed to be done; that is to say, do you expect the reactor to be furnished for nothing, or do you expect to pay for it, or what?

Mr. ELLIS. We would expect Atomic Energy Commission to proceed with us on an experimental basis in these early plants, providing us either with heat as AEC is doing substantially at Shippingport for the power company, or in some other means absorbing a substantial amount of the experimental costs, if not of the reactor itself, until we can see where we are on a continuing basis. We believe that is the only way it can be done, Mr. Hinshaw.

Representative HINSHAW. I agree with you that they have to absorb most of the cost if you are going to get down into that range of cost under present circumstances. It is hoped that in the future something may be developed that may come down somewhere in the range of United States production costs. Certainly for the present it is away out of sight.

We know that the Army has contracted for the building of one 10,000-kilowatt reactor that may provide power. We have no experience with that reactor as yet. So far as I know, they don't expect it to deliver power at anything like competitive cost in the United States. I just wonder whether this is a study proposition or whether it is an active proposition in which you expect to have these things done now.

Mr. ELLIS. We just believe that only through this type of thing is the United States going to get going at all in an atomic-energy program.

Representative HINSHAW. We are getting going. There are a number of reactors being built, mostly for the military.

Mr. ELLIS. That is right, sir.

Representative HINSHAW. So it is not that we are standing still by any means. A reactor to provide power or heat, either one, for one installation is just as good in one place as it is in another. It doesn't make any difference where you install it, except that it must have some conditions surrounding it, of course.

Chairman ANDERSON. But would it not be true that a reactor in the Chugach area, where electricity is limited in the first place and it costs around 20 mills, has a much greater chance to succeed than it would if it were put in the Columbia River Basin, where the cost is 2 or 3 mills?

Mr. ELLIS. That is right, sir. We would expect the atomic reactors to be justified feasibly first in the high power cost areas, which raises a question in our minds why AEC approved that first big one in Shippingport, Pa. right on top of the coal mines.

Representative HINSHAW. Mr. Chairman, may I point out that somewhere above Anchorage—between Anchorage and Fairbanks, Alaska—there is a 40-foot coal vein. It is not that they are without fuel in that part of the world. They have lots of fuel there.

Chairman ANDERSON. But in the plant at Anchorage the generation of current is not only high priced, but the quantities of it seem to be greatly limited. The Government finished the Eklutna project at tremendous cost. I would have hoped it would have been contributing to this power rate by now. It was not finished in 1952 or 1953, or

whenever I saw it, but I understand now it is completely finished, and it is operating, and I would hope that its costs go down some.

There are enormous veins of coal up there, of course, but there are a great many problems in transportation back and forth. There is no great amount of coal right in the Anchorage area.

Representative HINSHAW. It is between Anchorage and Fairbanks. I forget exactly how many miles, but I think it is about 40 miles out of Anchorage.

Mr. ELLIS. We have explored that in the process of justifying the generating plants we have there at Anchorage now for the cooperative operating outside of Anchorage. The cost of getting that coal is very high.

Representative HINSHAW. I grant you it is a high cost area, largely because the quantities produced have been small.

Chairman ANDERSON. Very small.

Representative HINSHAW. The smaller the production, the higher the cost. With a large quantity of production you can cut that cost considerably.

Mr. ELLIS. Yes; you are right. There are two other factors there. Labor costs generally are very high in Alaska, and there is so much of the year that you cannot transport; you cannot even work, as a matter of fact, in some of the areas. That, too, tends to raise the cost.

Representative COLE. Mr. Chairman, I would like to inquire of Mr. Ellis why it is that the cost of power in Minnesota is about the same as it is in Alaska.

Mr. ELLIS. I was just looking a while ago at this map here on the wall, Mr. Cole, of the water-resources development in the United States. You will notice there is none in Minnesota. There is none very close to Minnesota, the Missouri River being the closest to the west in the Dakotas. All of that area in the United States where there is not waterpower development, our wholesale-power costs are high. We actually think it is more related to the yardstick effect of waterpower development than it is to the availabiity of fuel in the area.

However, the Minnesota area is also deficient in natural fuel. Our own rural power cooperative, which is located north of Minneapolis, has its coal barged into the Minneapolis-St. Paul area, and then trucked from there north into the area where it is used. That is the best explanation I can give why the costs are high.

The rural electric systems are interested in obtaining as much information about atomic power as possible. Eleven of them (in such varying areas as Kansas, Ohio, Oklahoma, Minnesota, and Florida) have received access permits. Our systems are making a sincere effort to learn more about the possibilities of atomic power as applied to their very serious wholesale-power problems.

The interest of the rural electric systems in atomic power will probably continue to be very keen because we have such serious wholesale problems with us year in and year out. There doesn't seem to be any permanent solution to some of these problems. For instance, we are still plagued with very high wholesale-power costs in many areas. For the fiscal year ending June 30, 1954, our systems spent almost $109 milion on purchased energy. They purchased 46 percent of their power requirements from private power companies, 30.7

percent from Federal agencies, 8.1 percent from other public agencies, and generated 15.2 percent themselves. Our wholesale-power costs are highest in the Northeast, New England, and the North Central areas of the country, as illustrated by the following average wholesale-power costs paid by the rural electric systems during the year ending June 30, 1954:

Maine, 15.1 mills; Minnesota, 13.5 mills; Wisconsin, 13.3 mills; Michigan, 12.8 mills; New York, 11.2 mills; North Dakota, 10.1 mills.

Our average cost of wholesale power during the same fiscal year was 7.6 mills. These high wholesale-power costs make it essential that the rural electric systems consider thoroughly any energy source which may offer some hope of relief.

The rural electric systems generate only about 15 percent of their power needs. These generating costs in some areas are also high. For the first 9 months of the year 1953, the most recent data available, they ranged from 4.32 to 20.7 mills. These costs are high because many of the plants are located in high fuel areas and because their generating units are small. In fact, during the year 1953, the average internal-combustion plants ranged from 1,805 to 12,500 kilowatts in size and the steam plants from 14,000 to 106,000 kilowatts.

Representative COLE. What is the location of the plant that produces 4.32 mills, and the size of it?

Mr. ELLIS. Mr. Cole, I am embarrassed that I can't give you that.

Representative COLE. Do you know the other one, the 20.7 mills, your highest cost?

Mr. ELLIS. No.

Representative COLE. Would you supply for the record the location of your cheapest unit and its size, and the location, and the largest?

Mr. ELLIS. I shall be happy to. Normally our electrical engineer would be here, but he happened to be out of town at this date.

(The information referred to follows:)

NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION.
Washington, D. C., February 21, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
United States Senate, Washington, D. C.

DEAR SENATOR ANDERSON: You may recall that during the presentation of my testimony before the Joint Congressional Committee on Atomic Energy on February 15, 1956, Congressman Cole, of New York, asked several questions with respect to production costs at REA-financed generating stations. In view of the fact that the requested information was not immediately at hand, permission was granted to furnish the requested material at a later time for the record. This letter is to transmit the supplementary information requested.

During my appearance, I stated that during the year 1953 the size of REA-financed steam units ranged from 14,000 to 106,000 kilowatts. The 106,000-kilowatt figure referred to is the total installed capacity of 3 units at the generating station of the East Kentucky Rural Electric Cooperative Corp. There are actually two 22,000-kilowatt units and one 66,000-kilowatt unit at this station.

Congressman Cole asked me the location of the plant that produces energy at 4.32 mills per kilowatt-hour and the size of it. We are informed by REA that the 4.32-mill figure refers to the Brazos Electric Power Cooperative, of Waco, Tex., which operates a 23,000-kilowatt steam station. The REA figure of 4.32 mills represents operation during the first 9 months of calendar 1953 and includes all overhead items allocable to production. Our own studies indicate that this plant, for the period January through October 1954, produced power at 3.06 mills per kilowatt-hour. The 3.06-mill figure represents production expense, including supervision, engineering, labor, lubricants, water, maintenance, sup-

plies, and fuel, but excluding depreciation, taxes, interest, insurance, and administrative expenses allocable to production components. Fuel costs during this period for the Brazos plant were approximately 2.09 mills.

Mr. Cole further inquired as to what REA-financed generating plant had experienced production costs of 20.7 mills per kilowatt-hour. The 20.7 mill figure represents REA's estimate of the total production cost at the Warroad 3,885 kilowatt internal combustion plant of the Border Counties Power Cooperative in Minnesota. The REA figure represents operation during the first 9 months of 1953. Our own figures indicate that the comparable figure for the period January through September 1954 is 18.29 mills per kilowatt-hour. All of these figures with respect to the Warroad plant include not only supervision, engineering, labor, lubricants, water, maintenance, supplies and fuel, but also include 6.08 mills per kilowatt-hour of overhead expenses allocable to power such as depreciation, taxes, interest, insurance and administrative expenses.

Mr. Cole also asked me to supply for the record the size and location of the REA-financed plant producing energy at the lowest cost and the location of the largest single unit. As far as we can determine from the operating figures made available to us by the G-T cooperatives, the lowest cost generation is produced at the Ladysmith 1,800 kilowatt hydroelectric station of the Dairyland Power Cooperative of LaCrosse, Wis. Production expenses for this unit for the calendar year 1954 were 1.22 mills per kilowatt-hour and total production costs were 1.69 mills per kilowatt-hour including overhead items. The lowest cost REA-financed steam electric units, according to our studies, are the two 11,500 kilowatt units of the Brazos Electric Power Cooperative of Texas previously referred to.

The largest single steam electric unit financed by REA is the 66,000 kilowatt unit of the East Kentucky Rural Electric Cooperative Corp. previously mentioned.

I trust this is the information desired by the committee, but I shall be happy to furnish further details if they are desired.

Sincerely,

CLYDE T. ELLIS, *General Manager.*

Mr. ELLIS. Their load factors are low. They average about 45 percent.

The loads of the rural electric systems are still doubling about every 4 or 5 years. In other words, each 5 years we must find somewhere about 100 percent more power. This compares with the whole utility industry whose loads are doubling about every 7½ to 10 years. We cannot envision the day when these loads will stop increasing.

Probably one of the most significant recent developments is the report of the panel on the Impact of the Peaceful Uses of Atomic Energy. This panel undoubtedly will have considerable influence over the future course of our atomic power policies. I would like to comment on some of the recommendations of the panel as they relate to our particular problems.

We can agree with some of the panel's recommendations and on others we have reservations. We are disappointed that our association was denied the opportunity to present its views before the McKinney Panel. The rural electric systems had no representation on the panel—the power companies did—and we were denied the right to appear before the panel.

Our only opportunity to present our views was when we were asked to suggest someone to serve as a member of a secret power seminar which was to report to the full panel. We were asked not to suggest someone who was familiar with power production. We nevertheless suggested a manager of a generation and transmission cooperative who is one of the original members of our Atomic Energy Study Group and who is very well informed on atomic power developments. We were informed that this man was turned down by the panel because

they wanted to have people who were not so involved in the atomic power field and who could take a fresh look at the issues and come up with some new ideas. We were told they did not want one of our generation and transmission co-op managers. We were also told at the time that there would only be one representative from the power companies at this seminar.

Representative COLE. May I inquire if those instructions from the panel were communicated to you by letter or orally?

Mr. ELLIS. It was orally. We discussed them several times and I am sure that my statements would not be challenged.

Representative COLE. It seems rather strange to me that this panel would solicit individuals to enter into a discussion of the subject and require that the individuals who participate in the discussion not know anything about the subject.

Mr. ELLIS. It seemed very strange to us, too, Mr. Cole.

Representative COLE. That is why I inquired if there was anything clear and direct about the communication.

Mr. ELLIS. They said they wanted more a grassroots slant on the needs and so forth. They did not want experts.

Chairman ANDERSON. They did have a power seminar, and a man named Eaton was there, was he not?

Mr. ELLIS. Yes, sir, I am coming to a discussion of that.

Chairman ANDERSON. You recognize, I suppose, that in a nine-man panel it is pretty hard to take care of everything. Sam Morris was president of the Public Power Association as Sutherland Dows was a representative of a utility company. I did think that Sam Morris was a representative of public power users or otherwise he would not have been elected president of the association by public power groups. While you would have been happy to have a man specifically representing REA's, there were only about two dozen other groups who would also like to have people representing their groups, and it is hard to squeeze them all into a nine-man panel. That is the only explanation I make of it.

Mr. ELLIS. Mr. Chairman, I think it is an error that he was at that time president of the American Public Power Association, but he had been president, and he is no doubt well representative of that branch of the industry. There are three branches of the industry as we look at it when it comes to distribution. There are the commercial companies. They are the biggest, of course. Then there are the public groups, the municipally owned systems, principally. Then there are the private electric cooperatives. The private electric cooperatives are the ones they excluded or would not permit to be members of the panel.

Chairman ANDERSON. How do they differ from the public electric cooperatives?

Mr. ELLIS. We don't regard them as public.

Chairman ANDERSON. You mean an REA co-op is not a public group?

Mr. ELLIS. It is private as we regard it.

Representative HINSHAW. I have always been of that impression. I am sorry I have been wrong. I hate to be wrong. I always thought they were public, and that is why we financed them in the Congress of the United States.

Mr. ELLIS. No. I think the courts have rather consistently held that cooperatives are private. They are privately owned by the members.

Chairman ANDERSON. I become confused over the fact that when I was Secretary of Agriculture we had the Rural Electric Administration in the Department of Agriculture, and came regularly to the Federal Treasury for power to loan money to these co-ops. You naturally get an assumption that there is a connection with the public.

Mr. ELLIS. Yes, that is a common point of confusion.

Representative COLE. Isn't it true that between public utilities and co-ops, it is really a distinction without much difference? Essentially they are the same.

Mr. ELLIS. Between public utilities and co-ops?

Representative COLE. There are technical differences, of course, but they are legalistic, rather than substantial.

Mr. ELLIS. You are right in that there is one very great area of common interest in that they are both consumer-owned. That is true. But the rural electric cooperatives do not have many of the advantages of a public entity of government such as a public power district, or a municipality. The rural electric cooperatives for the most part do not have the right of eminent domain. The rural electric cooperatives are not exempt from taxes, as a rule. There are 1 or 2 States where they are by constitutional amendment. But for the most part they have to pay the same taxes as the private companies do, and it amounts to much more, we think, as a rule, because our investment has to be so much more per amount of gross income.

Representative COLE. When you say they pay the same taxes, that is not quite accurate.

Mr. ELLIS. We think we usually pay more.

Representative COLE. You don't pay any income tax.

Mr. ELLIS. No.

Representative COLE. So the statement that you pay the same taxes is not quite accurate. If you had income, you would not be taxable. Cooperatives do pay taxes on their properties—real-estate taxes, the same as private utilities, but there is no business tax.

Mr. ELLIS. There is a ruling, I believe, of the Internal Revenue Service, that if a certain percent of our income should come from nonmembers, then we are liable for the income tax.

Representative COLE. Your objective is to operate without a profit.

Mr. ELLIS. Yes. We have to in order to operate at all in these sparsely settled rural areas.

After this turn down we suggested at the McKinney panel's request, another manager, a manager of a distribution cooperative, who was not so well informed because he had not had the opportunity to serve as long as a member of our study group and he had not had experience in power production. This choice was accepted by the panel.

We were later surprised when this manager informed us that some members of the seminar were people who were heavily involved in the development of atomic power and that, instead of 1 power company representative at the seminar, there were 4 members who were employed by or associated with large private power companies. Also 1 of the 2 technical consultants to the seminar was an employee of the power companies.

Because of the inability to adequately present our views to the panel, we approached the final report with some apprehension.

I would like to comment first on the panel's recommendation 2 which appears on page 2 of the report. The first part of this recommendation states that if industry does not take on the full risks and burdens in developing an atomic power program, the AEC should do this. Surely there has been ample time for industry to demonstrate its ability and intent in this respect. We believe that as long as the AEC waits for industry to do this, the program will be delayed unreasonably. We agree with the panel that the program should not be delayed while waiting for industry to assume its part of the burden.

There are many things to substantiate the fact that industry is not assuming the full risks and burdens involved in developing an atomic power program. There is only one reactor under construction which will operate under normal utility operating conditions. This is the Shippingport, Pa., pressurized water reactor which is being constructed by the Westinghouse Electric Co. and will be operated by the Duquesne Power Co. The AEC is paying 85 percent of the cost of this reactor and the power company the other 15 percent, but the power company has obtained a tax write-off on its share of the total cost, and we figure this tax write-off will almost pay its part of the costs. I will not elaborate on this because Dr. Clay L. Cochran of our staff is going to present a brief statement on our position on the tax-amortization program which we note by the way has been listed by the panel on page 142 of their report as a significant "indirect financial aid" which could be used in the development of atomic power.

Representative COLE. Mr. Ellis, with respect to the degree or extent of effort by private capital or private industry in this field, which you say is not sufficient in your judgment, apparently you don't feel, then, that the program which at present, as I recollect, is 8, 10, or 12 reactor projects that are now underway, developed in the last 18 months since this change in law, is not sufficient progress?

Mr. ELLIS. No, sir. This is the only one under construction in the utility field.

Representative COLE. I know there is only one that is actually under construction, but there are nearly a dozen that are in various stages of prosecution.

Mr. ELLIS. Not that have been approved by AEC.

Representative COLE. I think there are 8 or 9.

Mr. ELLIS. Not that have been approved.

Representative COLE. There are 3 or 4 that are pending that are still under consideration. There are about a dozen, roughly, that either have been approved or are pending, and will likely be approved. That is an average of 1 project for every 45 days of the law. It seems to me that it is rather startling and prodigious progress.

Mr. ELLIS. There are two points there that I would like to make. One is that the present law simply replaced another law, and the atomic energy program of the United States has been in progress now several years. The point I am making is that regardless of what the law is, or regardless of what has been done, the atomic energy program in the United States, in my opinion, is lagging, and lagging behind probably what is going on in other countries in the world. We simply ought to do whatever is necessary to get this program rolling.

I further believe that if the Atomic Energy Commission really feels that there are possibilities—real possibilities—of development of these many types of reactors that there ought to be under construction reactors of various sizes in those types.

Furthermore, it is our belief that some of these reactors ought to be under construction by other than the private companies. By the rural electric systems, for instance. We don't think we can possibly get a yardstick of operations from the Shippingport plant. There are several reasons for that. One is because it is being made a part of a big power company whose books will not be available to us or to anybody except, possibly to some extent, to the regulatory bodies.

Representative HINSHAW. Mr. Ellis, let us get down to cases. The Shippingport plant is supposed to be the first step-up from the small reactor to a large reactor. As I remember its consideration by this committee at the time it was first dreamed up, they thought that 65,000 kilowatts, or whatever it is, was a tremendous amount to be generated by one reactor. We didn't know whether the reactor would blow up or whether it would do this or that or the other thing. It was placed away outside of Pittsburgh close to the source of power demand so that it would not do any damage and at the same time have a market.

That was done for a specific purpose. The purpose was a step-up in size. The next step-up in size will be something in the neighborhood probably of 200,000 kilowatts. If you can think of a better place to put it than that, I would like to know.

You are talking about a 10,000-kilowatt reactor. A 10,000-kilowatt reactor is being produced under contract with the Army. We will find out a great deal from that. This thing is an entirely new art. We don't know anything about it except theoretically. We are about to find out what it means practically.

If you think that this committee, which is the watchdog of Congress over the Atomic Energy Commission, has been laggard in its duties—and we certainly have been watching this program for a long time—you should have brought it to our attention.

Mr. ELLIS. Mr. Hinshaw, I don't want to be misunderstood here. Let me emphasize again that in my opinion the development of one reactor of one type and one size like either the Shippingport plant or the Army reactor, is simply going to provide development in that specific narrow area. I believe there should be a broad front approach. I believe that the industry believes it. I hear lots of this from the people of the industry who apparently are scared to come in here and testify what they think before this committee for fear that their negotiations with AEC will run into trouble. We have heard them say that. We have heard them indicate that.

Representative COLE. In confidence?

Mr. ELLIS. There is an article in the Wall Street Journal which I believe I have right here, which indicates that is the reason they are not in here. The are simply afraid. They are afraid of recriminations from AEC. That is the way I interpret it, at least.

Representative HINSHAW. That is the first time I ever heard that recriminations will be held over the heads of people who are trying to make progress. I can't understand it.

Representative COLE. Does the article identify the corporations which are apprehensive?

Mr. ELLIS. I do not believe so. I just read it hurriedly this morning, "Private industry declines almost unanimously to tell Congress what it dislikes in atom law." And it is in the Wall Street Journal of Tuesday, February 14, 1956.

Representative HINSHAW. That is to tell Congress and not the AEC.

Mr. ELLIS. That is to tell this committee.

Representative HINSHAW. Certainly.

Mr. ELLIS. The article strongly implies that the industry is afraid to come in and tell this committee its objections to its problems or what is wrong with the AEC while it has negotiations going on with the AEC.

Representative HINSHAW. I think that ought to be placed in the record. I have not seen it.

Representative COLE. Of course, it could be that industry does not have any serious objections, and therefore does not wish to take the opportunity of presenting testimony.

Mr. ELLIS. We have talked, I believe, with most of the major companies that are interested in building reactors, and I can tell you that it is my opinion that most of them do have objections. The small fellows feel they are not getting in on the program at all.

Chairman ANDERSON. Merely just to straighten out the record a little bit, your statement says that this recommendation No. 2 is on page 20 of the record. I could not find it there. I finally located it. It is on page 2 of the report.

Representative PRICE. Mr. Ellis, did you come to your conclusion on the statement that you just made based on this Wall Street Journal article in this paragraph—

> Back of the almost unanimous decision by private businessmen not to appear before the committee in slated hearings this week looms the fact that many of the firms asked to testify have negotiations going on with the Atomic Energy Commission. Some industry members contacted suggest that it would not be good for them to criticize the Commission in public when they are negotiating contracts with the same agency.

Mr. ELLIS. Yes, sir, that is one of the stronger statements, but there are other references to it.

Representative PRICE. Mr. Chairman, I ask unanimous consent that this entire article be included in the record.

Chairman ANDERSON. I am not going to object, but I want to say to you that the person who wrote that article talked at great length to me, and I tried repeatedly to stress that fear of AEC reprisals had nothing whatsoever to do with it in my opinion.

I have a letter here from the head of Consolidated Edison, who thought that his letter was as good as his personal appearance. I am going to do what that man requested, and take his letter, because Mr. Searing gave me a great mental lift when he testified a year ago. We had testimony from the Atomic Energy Commission that no one would build a reactor without Government participation, partnership and subsidy. Mr. Searing came in and said, "I will build one without any help. I want a license. I don't want a partnership agreement. I don't want the Government in my business." He pleased me enormously with that declaration.

Along came Commonwealth, and they testified that they would be glad to build one. That is Commonwealth Edison of Chicago. It took them a long time to come to that decision, because there were some

very heavy questions involved. Mr. Willis Gale is going to be here and testify. I have discused the problems with him. He is not stepping out of this hearing because he is afraid of anybody.

Representative PRICE. May I withdraw that request until I have an opportunity to read the article?

Chairman ANDERSON. Thank you. The next is Detroit Edison, and they are negotiating and Walker Cisler will be here to testify and is happy to do so.

I have a telegram from Philip Sporn, who is head of the American Gas & Electric, who will come here and testify.

I tried to say to the individual writing this article when he announced his assumptions to me that I thought his assumptions were entirely incorrect, that they were badly taken, and I thought no useful purpose would be served by writing such an article. The article exemplifies my great influence over the press. [Laughter.]

Thank God we have a free press in America, and you can say anything you want to.

The assumption is not correct, because several of these individuals have taken occasion to say—

> We are not ready to say how we think this law is going to operate. We came in last year at great length because we wanted to get a first crack at the law.

Last year we had an interesting side line in the Dixon-Yates contract which brought a great many people out, and which I had hoped I would not mention this time. I am not too sure that the operators are afraid to be here, and I think the fact that the three biggest ones that were starting off, Consolidated of New York, Commonwealth of Chicago, and Detroit Edison, do plan to be here or have submitted a statement in writing which I am going to read into the record, is some indication that they are not shaking with fright, at least.

Representative COLE. Furthermore, Mr. Chairman, it would seem to me that if any of the organizations interested in this field were critical of the way the Commission is operating or critical of the law, they would communicate those criticisms to either the chairman of this committee, or the one who had been chairman of the committee, and who had some hand in writing the law. I can assure you, and I hope the gentleman who wrote that article for the Wall Street Journal, that I have not received a single letter of complaint either of the operations of the Commission or complaint of deficiencies in the law. I have not received a single letter from anybody whatever.

If there were widespread dissatisfaction with the Commission's operation or even if it were minor, it would seem to me that dissatisfaction would be communicated to Members of Congress.

Mr. ELLIS. Maybe it will be yet. We hear industry talking in that vein. That is the substance of my statement.

Representative COLE. Maybe it is there. Maybe there is criticism. Why doesn't it express itself?

Chairman ANDERSON. I think one of the factors that we might just as well mention frankly is the insurance factor. The stock insurance companies have announced that they will have $50 million worth of insurance available. The question has arisen as to the responsibility of a manufacturer for what might be called product. People who produce Coca-Cola, for example, have a product liability policy. If anybody says there is anything wrong with that product, they can

come back and sue and if it is a large corporation, they want to be sure they are not going to be taken out of existence by that suit.

The man who makes a reactor has been advised by his attorney that he may have products liability insurance. Naturally he is going to think about that. The people who are going to build these first three or four or five large reactors begin to wonder what might happen if anything went wrong with the reactor.

Secondly, they are not too anxious to come here and say out in an open meeting that this thing might blow up because that immediately gets translated into the possibility that it is going to.

I follow the belief of Dr. Bradbury and Dr. Lawrence and Dr. Zinn, and a great many other very able reactor people, that there will never be a reactor explosion. They have learned how to control these things. The first time I went into a room and saw them saw dynamite with a buzz saw, I wanted to get out of there. But they told me that they found a way so it was safe. I believe these people have found a way of building reactors so they are absolutely safe, and will never blow up.

Yet, as Congressman Hinshaw suggested, the Shippingport reactor is a little ways out of Pittsburgh. I have been over to its site on the river. It is in a very beautiful location. But it is a few miles from downtown.

The Commonwealth Edison plant will be built 45 miles away from Chicago. So that if there is some unusual occurrence, it is not going to destroy lives. Those things involve not just a question of $50 million worth of insurance. $50 million would replace the plant, perhaps, and pay damages for some of the human life that might be lost in the way of compensation payments due to the workers, it might cover the property damage of surrounding houses and mashed up automobiles, but if there was, as well, fallout from it which dropped onto a large city like Chicago and caused many genetic mutations a few generations away—I am not saying that is a possibility, but people have talked about it—do you have a brandnew type of liability?

Frankly, I feel that the liability problem is still a very large problem that has not yet been completely settled. This committee, in my judgment, just as it did under the fine leadership of Mr. Cole, will finally come to additional consideration of that problem.

I have tried to say to the representative who wrote that article, and I am happy to say it out here in open meeting, that I think part of the reason we have not had as many people testifying as we might is that one of the first questions that might be asked of Consolidated Edison is "How much insurance do you plan to carry?"

If Mr. Searing would reply, "$50 million worth is all we can get" and is asked, but you are going to put more than that into a reactor, and suppose you get a claim for $1 billion of damages out of New York City, how would you pay it? He would have to say, "I assume we can't pay it." Then somebody would say, "Make him build his reactor some place else where he can't cause a $1 billion worth of damage."

Frankly, I want to see him build his reactor close to New York. I want to see him integrate this rather high-priced power with the lower cost of generating and subsequently he will be able to give us the cheaper type of current, but it will take experiments and tests.

I only hope that Consolidated in New York, Commonwealth in Chicago, Detroit Edison, the Yankee group of the New England

States, the REA cooperatives that applied, all will build reactors and no stone will be in their way. I do think that constant fears about a plant blowing up would be a deterrent. I don't think those fears are justified. But as you well know, I am not an expert. I would like to bring in some expert testimony on that point.

I only want to express to you my conviction that those things are more the reason why some of these firms are not here than any fears that the AEC will have any reprisals against them if they testify frankly about the program. You are entitled to your opinion as much as I am to mine.

Mr. ELLIS. Other countries appear to be going ahead with dynamic atomic power programs to meet commercial needs. We believe laboratory construction and operation of the reactors is essential to an atomic power program, but we also believe we will not have a real program until several reactors are constructed and operated under normal utility operating conditions and then under circumstances where costs can be readily measured, which we don't believe can be done at Shippingport.

Officials of the AEC admit that private industry is not taking the initiative it should in developing atomic power. Kenneth Davis, Director, Division of Reactor Development, stated in the press seminar on civilian power reactor development held at the AEC on December 6, 1955:

> * * * Pennsylvania Power and Light, who are planning to build, with the assistance of Westinghouse, a homogeneous reactor, having it built in 1962. They are saying they will only build it if by 1958 it looks as though it will be economic when it is completed.

In other words, the private power company wants to be certain that they are building what amounts to a sure thing. If your atomic energy program must go ahead on this basis, I am sure there will not be many power reactors built and our country will continue to lag behind other nations in this respect.

Representative HINSHAW. Mr. Ellis, may I point out that there are some questions as to whether or not the expenses of such a reactor, if it doesn't look economical, can be charged into the power rate, that is, the cost of the reactor. That is a very serious question for power companies that are privately owned, not private cooperatives such as you have. That is as to whether or not they can write the cost of such a project into the base for rate purposes. They certainly can't write any more in than would be acceptable under normal power production conditions. Would you not agree with that?

Mr. ELLIS. I agree with your broad statement, but I don't believe that is correct where commissions, I believe, are going to recognize that there is value in getting a first plant going, and value in experiment. I believe, for instance, that the Duquesne Co. is putting in substantially more into the overall project than it would put into a conventional project to get the same amount of power.

Representative HINSHAW. It being an experimental plant, so to speak, they certainly ought to take a look at it to see whether it is economical or not, and whether or not they may expend the money, because their entire books are subject and their finances are subject to the regulation of a utility commission of a State. The State utilities commission will tell them whether they can write certain things into their base or into their cost. Is that right?

Mr. ELLIS. That is right. I believe the trend is for the commissions to permit them to go into the atomic basis on greater cost than the conventional plants.

Representative HINSHAW. I would like to know what the decisions are up to date, if any decisions have been made.

Mr. ELLIS. I think they have.

Mr. COCHRAN. I think we can get the decisions of 1 or 2 State Utilities Commissions.

Representative HINSHAW. I don't think any proposals have been put up to a Utilities Commission to decide yet.

Mr. COCHRAN. Yes.

Representative HINSHAW. How can they be put up?

Mr. COCHRAN. It is an advance opinion of the Commissions that if they invest money in one of these atomic recators, that they will be permitted to include that in the rate base.

Representative HINSHAW. I would be very happy to know that, and I would be quite interested, because certainly it would have an effect on the program which we are to consider.

Representative PRICE. Mr. Chairman, may I make just on comment, because I have noticed throughout Mr. Ellis' statement so far he speaks of our lag behind the rest of the world in the development of atomic power reactors. I don't think that is factual. I know of no evidence aywhere that indicates that we are behind anyone else in the development of power reactors. I am pleased to see the interest and the great interest of REA in this reactor program. I hope it continues. I think you are wise in participating in the program. Just as I think the American private utilities are wise in participating in it.

I happen to be one of those who wants to prevent a lag in the program just as you do to the extent that I have some thinking along the line that perhaps the Commission should show the lead in a crash program to build a reactor to prove its worth and feasibility. I know of no evidence that we have ever had before this Committee at any time that indicates that the United States is behind any nation in the development of power reactors.

Chairman ANDERSON. Probably, Mr. Ellis thinks the fact that the Russians have a 5,000 kilowatt plant operating, and have had for some time, and they have a 100,000 plant that may be in operation well ahead of Shippingport. It may not. The British have started to build two of these large plants a year and they are under way.

Representative PRICE. I don't think we are behind any of them in the development of these reactors. This does not alter my personal opinion that we should get into the thing a little more thoroughly than we are, and possibly for the Commission to conduct a crash program to be certain that we never leg behind any other nation.

Mr. ELLIS. I believe, Mr. Price, that the AEC people themselves, or some of them, have agreed that while in their opinion the United States is probably ahead of the rest of the countries in the laboratory developments, that it may not be in terms of some of the actual construction of projects. While some of them argue that some of the projects that are being developed in other countries are of types that do not hold the promise of some of our laboratory tests, still it is our opinion that you are going to get actual plants in operation to get the experience that is necessary.

Representative PRICE. I agree with you 100 percent in that opinion. That is what I want to see. I want to be certain that we don't lag behind any other nation.

Representative HINSHAW. I am sure the gentleman will agree also that is the very reason why the law was changed through the work of this committee and that we have released the atomic energy program from being purely military toward one for the peaceful uses of atomic energy. That is the very purpose of the committee in doing that, and it is the very purpose that is being carried out now. If other countries have devoted their energies in some greater amount than military application, for the production of reactors, it is no sign that they are ahead of the United States, nor that they have better designs nor that the power can be produced any cheaper.

Chairman ANDERSON. Mr. Ellis, the panel report to which you have referred, in volume 2, page 362, deals with the British program a little bit, and points out that the British program is under way. Two experimental powerplants are now being constructed, and that the British Government has issued a white paper outlining the program of the construction of 16 reactors capable of producing 1,500 to 2,000 megawatts of electricity at a cost of about $300 million. That is about 100,000 kilowatts apiece.

Would it be your theory that if that were true, and the British Government goes ahead with that, that it has a pretty ambitious program with which we better keep in step?

Mr. ELLIS. Yes, sir. It is also my opinion that as far as construction is concerned that they are ahead of the United States.

Chairman ANDERSON. I think some of us saw some of these large reactors under way. I think one factor that we should bear in mind is that the plant that goes into the *Nautilus* or *Sea Wolf* are also pretty well known operating reactors.

Representative HINSHAW. Mr. Chairman, I certainly believe that the members of the committee know that one of the reasons why we encouraged the Geneva Conference was because we were thoroughly of the opinion that perhaps the first reactors of any size would have to be built abroad where the competitive prices of electric power were so much higher than they are in the United States.

For example, in Spain and Great Britain, and perhaps Australia, and some other places, they can use a power reactor to much greater advantage than we can. When the experience has been gotten, then we may be able to get it down competitive with coal and hydro power in this country.

Mr. ELLIS. Mr. Chairman, I didn't come here just to criticize.

Chairman ANDERSON. I realize that.

Mr. ELLIS. I hope we have some constructive suggestions to offer as we go along here.

Demonstration power reactor program: In January of 1955, the AEC announced its first demonstration power reactor program. It stated it would welcome proposals from interested groups to construct reactors of different types and sizes. The deadline for receiving proposals was April 1, 1955. AEC received 4 proposals, 3 of which were ultimately accepted as a basis for contract negotiations. Only last week AEC announced the acceptance of the last of the four proposals. Almost a year has passed since the April first deadline

and still none of these plants is under construction and apparently none is near the actual start of construction.

Our country's atomic energy program is not getting atomic powerplants constructed, as it should in my opinion. Can we afford further delay?

We believe the results of the first round of the demonstration power reactor program supports the conclusion that the philosophy of the program is unsatisfactory. We believe it is not the best way to achieve an aggressive and dynamic atomic power program which is going to bring the benefits of this great new technology to our people and the people of the world as quickly as possible.

First of all, announcing rigid deadlines a few months away is poor policy. We believe that the AEC should administer this program with enough flexibility and originality so that they welcome new ideas any time they are proposed. One of our cooperatives had a rather bad experience in this regard. It submitted a proposal for the construction and operation of a small-scale reactor about the middle of June. It was told later that this proposal could not be received by the AEC because there was no program to accommodate it. The co-op proposal then had to be held over until the AEC's small scale reactor program was announced, the deadline of which was February 1, 1956, a half year away. When AEC announced the February 1 deadline on September 21 with its rigid specifications, other cooperatives could not get ready by then. And they cannot safely proceed now for they don't know that there will ever be another deadline or what the specifications will be. The specifications are constantly changing.

We are not used to operating under such artificial deadlines. We don't have the resources to do it. I would hate to think what the REA program would be like if REA stated periodically that a future date 3 months away it would receive all proposals for generation and transmission loans from the rural electric systems, changing the specifications each time and telling each one that it would have to compete with all the rest. We have been told that the justification for the AEC doing this is that they want to get some idea of what their budgetary requirements will be so they can make a sound request for appropriations of the Congress. As in other agencies, they should be able to estimate what these requirements are. If their estimates are too low, they can come in for a deficiency appropriation or if they are too high, they should be able to either return the money to the Treasury or carry it over until another year. It is very difficult for an electric utility to operate under such stringent time limits. This is especially true in the case of an atomic powerplant which may require detailed and time-consuming advanced engineering to develop a reactor type and design which can meet the specifications of the cooperative. It may also be necessary to carry on extended negotiations to obtain standby power in case the reactor must be shut down.

We also disagree with the basic philosophy of the demonstration power reactor program which has been explained by AEC officials as follows: (1) The AEC will construct reactors, not powerplants; (2) all proposals for the construction and operation of reactors under the demonstration programs must be closed end; (3) the manufacturer should take the risk in constructing the reactor and the utility the risk in operating it.

As for the first point, we believe the AEC has a narrow view of research and development. Its view seems to be that it should build the perfect reactor in the laboratory, and once this is done, its responsibility ends. It has a further responsibility to develop these laboratory reactors into working commercial atomic powerplants, we believe.

On the second and third points we believe it is very difficult for a nonprofit electric system to participate in a program that requires closed end proposals when there is so little known about the construction and operation of these plants. An example of the problems involved is the construction and operation of the fuel elements. There are manufacturing companies which are willing to give a closed end proposal on the fabrication of fuel elements, but there is no manufacturing company which seems willing to provide a performance guaranty for the operation of these elements. How could it?

Chairman ANDERSON. I am reminded of one of these companies that is wrestling with this problem, that it might be somewhat relieved by the action of the Atomic Energy Commission. The AEC is going to continue to own the fuel and it may be assuming some liability in connection with that.

Mr. ELLIS. That is right.

Chairman ANDERSON. It actually has the fuel element that it owns and leases to somebody else. This products liability question may be involved itself.

Mr. ELLIS. Yes, sir.

Therefore, once the utility making the proposal to the AEC reaches an agreement with the AEC on the amount of research and development funds it will contract for, for the operation of these fuel elements, and if the cost of operations of the elements greatly exceeds the estimate, the utility company operating the reactor must bear this increased cost. Under these conditions the AEC is very frank when it says the utility must take the risk in operating the reactor. But how can a small rural electric system absorb such risk? It does not have risk capital nor does it have a rate structure in which to incorporate such charges nor an extensive consumer base over which to spread such risk.

We cannot agree with Admiral Rickover when he stated in answer to a question at the AEC press seminar on December 6, 1955, relating how the utility absorbs the increased cost of a reactor:

> That is what the utility commissions take care of. This is the same situation you had when the electric industry started. It was high cost and the utility commissions took care of it.

Sounds like these utility commissions, being a good bunch of fellows, are available and able to take care of any increased cost incurred by an electric utility for whatever reason. We just cannot agree with this. The cooperatives try to keep their rates as low as possible in order to enable the systems to serve more farms, to enable farmers to make the most efficient use of this valuable hired hand, and to enable the co-ops to repay their loans to the Government. In many cases unfortunately our rates may be high because of low density and high wholesale power costs. In most cases the rural electric systems cannot raise their distribution rates any higher.

Representative HINSHAW. It seems to me, Mr. Ellis, that you are contradicting yourself in a sense when you say that the cooperatives don't have the rate structure in which to incorporate such charges

and then kid the utilities who try to ask the utilities commissions to do it.

I don't understand the logic in the presentation myself. You want somebody else to absorb any possible loss that there may be in operating a reactor for the private electric cooperative. Who is going to absorb it? Somebody has to absorb the loss.

Mr. ELLIS. Mr. Congressman, I don't mean to be inconsistent. I don't think I am. I simply say that the atomic energy program as set up and operating is not adequate to get the atomic reactors developed by either the private utilities or the rural electric systems.

Representative HINSHAW. Can you tell me any other way that that can be done by the Federal Government shelling out a lot of money?

Mr. ELLIS. I don't think it can. I think the Federal Government should do it if it takes that. What would be that proportion to the $15 billion that the people have put in this program?

Representative HINSHAW. Maybe 10 percent.

Mr. ELLIS. Maybe.

Representative HINSHAW. Most of that $15 billion, I would like to point out, was for the weapons program, and not for this.

Mr. ELLIS. That is true, but we have gotten lots that was necessary to get before we could go into the other from the $15 billion.

Representative HINSHAW. We won't argue that at this point. I don't want that $15 billion bandied about when it is very largely for the weapons program.

Mr. ELLIS. Most of the private atomic power plants which have been announced are actually to be constructed and operated by large combines of private power companies. One of these combines bragged it has assets of over $8.1 billion which is almost three times the total investment of all the rural electric systems. Such combines as this present a real threat of monopoly domination of the development of atomic power. We regret the McKinney panel did not look into this. A combine such as the one mentioned above can absorb some overage in atomic power research and development costs. Its companies charge it all to the ratepayers and the spread is so great that it is not significant to any one consumer. A small rural electric system such as the Rural Cooperative Association of Elk River, Minn., whose 6 member distribution co-ops serve approximately 40,000 consumers, certainly cannot do so. Does this mean then that the small nonprofit electric systems will find it difficult, if not impossible, to participate in these programs? Does this mean that the only yardstick or competitive elements in the utility industry will find it impossible to learn how to construct and operate generating plants utilizing what may be the dominant source of electric energy a few years from now?

We agree with Walter Reuther, a member of the McKinney panel, when he stated in his separate opinion:

> No private construction of power reactors has begun. No firm construction contracts have been signed. None of the private proposals has reached the end of the first of five stages which, according to the Director of the AEC Reactor Division, must be completed in order to test the commercial feasibility of full-scale power reactors.
>
> Because of the many difficulties to be overcome and the financial risks involved, we are told by this AEC official that there is today no definite assurance how many privately financed full scale reactor projects will be carried to completion, or whether any of them will.
>
> The utility companies are not powerfully motivated to develop new sources of low cost power. The policies of State regulatory commissions assure them a

fair return on their investment whether they expand or not, whether they increase power use through rate reductions or hold it back by keeping rates high. The incentive to them is rather to occupy the nuclear power field in order to hold it against the nonprofit public power systems.

We think it is unfortunate that the separate opinion of Mr. Reuther was not included as a part of the final printed report of the McKinney panel.

Chairman ANDERSON. It was not submitted to us until after the panel report had been printed, and had been printed for nearly a week. It is very hard to have something printed in here for which you don't have the copy at the time it goes to the printer, and you don't get it until after it has come from the print shop for more than a week. While it is unfortunate, it is not completely our fault. My copy of Mr. Reuther's comments was postmarked at 2:30 a. m., on the morning of January 31, and didn't reach my office until 11 o'clock. These printed copies had been issued to the press at 10 o'clock that morning, but it had to go to the printer quite obviously a week in advance. That is why his opinion physically could not be included. I am sure Mr. Reuther knows that. There is some good material in his separate report, but it was not submitted to us in time to be considered.

Mr. ELLIS. Of course, we did not know that. This is the first I had heard it.

Instead of a lot of talk about what private enterprise is going to do in constructing and operating reactors, we want to see some of them actually constructed. We believe that the only way this is going to be done is if the AEC does it itself. We think the Atomic Energy Act should be amended as necessary to incorporate the section 45 which was passed by the Senate during the debate on the Atomic Energy Act of 1954, but was lost in the conference. This is the so-called Johnson amendment. This would have permitted the AEC and other Federal agencies to undertake a real Federal atomic power program, and not be restricted to atomic power generation which is incidental to research and development. The Johnson amendment also contained an effective preference in the marketing of any Federal atomic power. If the Johnson amendment had been agreed to by the House with proper administration we could now have had some real atomic powerplants under construction. It would certainly be consistent with the traditional role of the Federal Government in the development of our energy resources to assume real leadership in an area where private enterprise is either unwilling or unable to do the job.

There are also some ways that this job can get started within the requirements of the present Atomic Energy Act. One of these is by the Gore bill, S. 2725, which was introduced July 30, 1955. This bill would authorize and direct the construction by the Atomic Energy Commission of six nuclear powerplants for the production of electric power. The bill states that each reactor should be of a different design and should be located in different geographical areas of the country. We believe the second part of recommendation No. 2 on power of the McKinney panel lends support to this bill. This part of the recommendation reads:

The Commission should support a program to bring atomic power to a point to where it can be used effectively and widely on a competitive basis, even to the construction with public funds of one full scale demonstration plant of each major reactor size and type.

The construction of such reactors by the AEC is essential not only to get this program off dead center, but also to accomplish two other things. One is to give us a yardstick with which we can actually measure the costs of constructing and operating atomic powerplants. We do not believe we will be able to obtain such measure of costs from the Duquesne Shippingport reactor. The second accomplishment could be to increase the amount of power available for civilian uses in areas where the AEC is using a large part of the available Federal wholesale power and creating civilian shortages. This is particularly true in the Northwest and the Tennessee Valley areas.

Our members at their recent annual meeting endorsed this type of legislation as is indicated in the resolution attached as exhibit No. 1. We hope this committee will hold early hearings on the Gore bill and that we will be afforded an opportunity to testify in support of it. We can ill afford the AEC's present inaction.

We want to see the AEC conduct an aggressive small scale reactor program. We agree with the following conclusion on the McKinney panel:

> The present development program is deficient to the extent that appropriate demonstrations of the small and medium size types are not now underway. The urgency associated with accepting the challenge to United States world leadership, together with the need for establishing atomic energy as a power resource available to assist in maintaining maximum expansion rates of the American economy, require the effective development and demonstration of all major reactor sizes and types be carried forward at high priority.

One way this can get underway quickly is for the Congress to appropriate sufficient funds with language directing the AEC to use such funds to permit small consumer-owned electric systems to construct and operate small and medium size reactors. Our members at their recent annual meeting unanimously adopted a resolution endorsing such action. This resolution is attached as exhibit No. 2 at the end of our statement.

Chairman ANDERSON. Mr. Ellis, I want to stop you there, because when you read that recommendation from the McKinney panel, I remembered that they proposed the construction of these plants. I think inadvertently you left out the first part of the sentence. You know that there is a way of proving the Bible says that "there is no God" if you take just those words. It does say "there is no God," but the whole verse says that the fool has said in his heart, there is no God.

In this particular case there is this proviso:

> In the event the industry does not take the whole risks and burdens, the Commission shall—

and so forth. That makes the assumption that industry does not move ahead. I think all of the members of this committee feel that if industry does not move ahead, then the McKinney panel report is very much in point. If industry moves ahead, it may not be so much in point.

Mr. ELLIS. I agree with you. I had covered that part earlier. I did not mean in any way to distort their recommendations. The principal thing I was calling attention to in this first sentence that I did read is that the present development program is deficient.

Also, we would like to request the committee to consider an amendment to section 132 of the Atomic Energy Act to permit the rural electric cooperatives and public bodies to obtain preference in the

granting of licenses for the construction of atomic powerplants for research and development purposes. This would apply to section 104 licenses. Now they are granted preference in the granting of section 103 or commercial licenses. At the present time a preference in the granting of 104 license may be more important because this is the type of license which probably will be granted for most reactors for the next few years. If we are given such preferred or antimonopoly consideration, it might enable us to participate more actively in this program and might cause the AEC to give our applications for research and development more consideration.

We wish to endorse all of the recommendations contained on page 10 of the panel report dealing with control of information. We believe the development of atomic power is essentially a civilian undertaking. We believe further it will be developed faster if everyone has an opportunity to participate in such development to the fullest extent of ability and ideas. This is very difficult because of the slowness with which the AEC is declassifying atomic power information and also the fact that it is not making such information available in such form that those who have an interest in this field can readily obtain it.

We would like to have the AEC publish periodic bibliographies which are distributed widely and which contain a description of the contents of articles and material dealing with atomic power. This bibliography could be divided into two parts: First, articles and materials of general interest to those whose main concern is with the economic and management problems involved in the development of atomic power; and, second, a more advanced bibliography dealing with design and other technical problems for those who are interested in manufacturing reactors or reactor components or interested in the actual construction and operation of reactors. At the present time there does not seem to be such a bibliography available.

Chairman ANDERSON. Doesn't some of the group that you have have one of these limited access clearances?

Mr. ELLIS. I have a Q clearance.

Chairman ANDERSON. If you have only an L clearance, there is put out at Oak Ridge every week, or at least every month, a complete bibliography of everything that exists. If you have an L clearance, you can get it. If you have a Q clearance it is like money in the bank. It is easy. With an L clearance you can get that bibliography.

Mr. ELLIS. We can't distribute that among our people. One of the things we are saying is that we think it ought to be available to everybody, and that they be permitted to read most of the stuff unless it has absolute military relevance.

Chairman ANDERSON. This is right over in my field. I am very much in sympathy, in general, with what you are saying. I do think there are problems in connection with that because sometimes the title of a paper contains information that in itself should not be made available. I don't say they are doing a perfect job, as you probably know from my comments in the past and probably more in the future. I think your criticism is interesting, and we will see if something along that line can be done. A complete bibliography is available to people with L clearance now at Oak Ridge.

Mr. ELLIS. One of our problems, Mr. Chairman, is that there is such a mass of this that is available, unless it is pinpointed we have difficulty. We cannot read it all.

Representative HINSHAW. Most of it I can't even read, if permitted.

Representative COLE. I don't see your consistency, Mr. Ellis, in complaining about the Commission's degree of classification, and in the next breath say they are pushing out so much that you can't digest it.

Mr. ELLIS. No. I am saying two different things. I don't mean to be inconsistent. One is that we would like to have the bibliography put out by the AEC organized in such a way that we can pick out of it those things which we may have time to read and study.

Representative COLE. I am not referring to the bibliography. I am referring to your statement where you say this is very difficult because of the slowness with which the AEC is declassifying atomic power information. That is your statement.

Mr. ELLIS. Yes, sir.

Representative COLE. In your extemporaneous statement you say the trouble is that there is such a mass of stuff that you can't digest it or absorb it all.

Mr. ELLIS. The main point of the two paragraphs which I have just read is that we would like the information declassified so that our people can read it around the country.

Representative COLE. You mean digest it so that they can understand it?

Mr. ELLIS. No, so they can have it at all. The Chairman brought up the matter of our little study group. I had not mentioned that here. Sure we have more material than we can read within this little study group. But we are only a few people. Most of our people around the country do not have clearance. Most of them are interested, or many of them are interested in this program, and they simply can't read much of this material at all. We would like it made available generally. We would like the secrecy cloak taken off, of as much of it as can be without disturbing our security from a military standpoint.

Chairman ANDERSON. I might say that this is not a matter on which there is not a great deal of interest. I handed a member of the staff this morning a letter which I just received pointing out that the AEC had declassified 8,965 reports, but it had left 6,465 classified confidential and 9,585 retaining the secret category. This says, this writer, a very competent person:

> It would be interesting and relevant to ascertain how many of the still classified reports are over 2 years old. This time period is generally thought of in industry as being the viable life of an industrial secret.

He points out that 2 out of the 5 reviewed reports are still classified. I would like to see these opened up.

I say to you that I would like to see it, too. I only know that the Atomic Energy Commission has a responsibility that I don't have. They have the responsibility to see that in declassifying this they do not reveal any military information.

Representative COLE. That is a very, very important distinction.

Chairman ANDERSON. Absolutely.

Representative COLE. It is easy enough for him to sit and criticize and anybody else to criticize or us to criticize but none of us are under the injunction of the law which the Commission is, which is to the effect that not a single item of information will be declassified if to do so will jeopardize our national security. There is a big difference. I

think all of us should have that in mind when we are complaining about declassification.

Mr. ELLIS. We do, sir. We agree fully with your statement. Some of the members of the Commission, as you may know, feel that there is material which could be declassified without jeopardizing our defense. I think if there were any doubt one way or the other, it must be resolved in favor of the defense.

Representative COLE. I am delighted to hear you say that, Mr. Ellis. I was sure that would be your position. But I am glad to have it on the record.

Representative HINSHAW. Then there is another subject and that is the availability of people who can read the papers once they have been declassified. I know they are thoroughly of the opinion that the mathematical sciences and the physical sciences teaching should be increased in the high school level so that there will be more students in college that will take courses that will produce people who ultimately can read these reports. I mean intelligently.

Mr. ELLIS. Yes, sir.

Representative HINSHAW. I think there ought to be more scientists and engineers who are trained in nuclear physics but they have to start in the high schools and probably even in the fifth and sixth grades to develop those people. We don't have enough of them.

Mr. ELLIS. We agree with you. We can understand the secrecy requirements which are necessitated by information which could be used in the development of weapons. At the same time we are in an intense competitive struggle in the world to see who is going to develop economic power the quickest and make the most fruitful use of it. To even keep up with other nations we must utilize the best thinking of all our people operating in an atmosphere where the free exchange of ideas is encouraged. Also we do not want to see atomic power burdened with high costs because of the necessity of maintaining unnecessary security restrictions. We find that a bit of a burden to use in our little study group now.

Insurance: We disagree in general with the conclusions reached by the panel in the section entitled, "Hazards, Protection, and Insurance" and contained in pages 12 and 13 of its report. We disagree because we believe that the Government must assume some of the risk involved in the operation of atomic power reactors. It must do so at least until the operation of such reactors is more proven than it is now. This is especially true in the case of the tremendous third party liability which insurance companies fear might possibly be incurred.

Developing an insurance program for power reactors can't be delayed. We disagree with the committee's conclusion that—

> at least 2 and possibly 3 years remain in which to conduct research and accumulate knowledge and experience before any substantial private activity can be delayed or stopped because of inability to obtain adequate insurance. * * *

Representative COLE. When you say you disagree with the committee's conclusions, you mean you disagree with the panel's conclusions.

Mr. ELLIS. I beg your pardon. That is right.

Chairman ANDERSON. I think that is a good place for me to put in the record, Mr. Ellis, just for future reference, that the findings and recommendations of the panel were not in any way submitted to the committee prior to their publication. You have two choices: One, you can have them submit a panel report and study it over and edit

it and try to turn it out as to what the committee finally subscribes to; the other choice is to let them turn it out and let it stand as what it was intended to be, as a report of this group of citizens, and no more than that. We turned it out on that basis. I did want you to understand that it was not submitted to the committee. Since Congressman Cole pointed that out, I wanted to say that.

Mr. ELLIS. Yes, sir. That was our understanding.

We have had three rural electric systems submit proposals to construct atomic reactors under the AEC's small-scale program. The part of these proposals requiring REA financing must be judged by REA on the basis of its present generation and transmission policy. Under this policy REA must make sure that the project is feasible. How can REA possibly determine whether the loan is feasible if it it unable to determine what the insurance for the reactor will cost? These decisions must be made now, not 2 or 3 years from now. We hope the Joint Committee will direct the AEC to immediately come up with some legislative recommendations to enable the Federal Government to assume part of the burden involved in the insurance on these early reactors. We have heard one group which made a proposal under the first round state that they will not turn a shovel of dirt until this insurance problem is resolved. If it is not resolved, this certainly will result in delaying or perhaps even stopping the program.

We wish to endorse recommendations 1 and 2 of the section dealing with Government organization contained on page 17 of the panel report. On our first appearance before this Joint Committee, we requested the committee to direct the AEC to establish a Division of Civilian Power with an advisory committee including adequate representation for the rural electric and public systems.

Chairman ANDERSON. I do want to make it clear that this committee does not direct the AEC to do anything. We are not set up in business to direct the AEC. Therefore, I merely want to point out that your recommendation can be made, but the committee would be powerless to direct it to do anything.

Representative PRICE. Mr. Chairman, may I point out there that I offered an amendment at the time the most recent act was under consideration in the House for the establishment of a Division of Civilian Power, but unfortunately that did not carry.

Chairman ANDERSON. That would be a way to get it done. If the law says there shall be a Division of Civilian Power, that is the Congress of the United, States, and I think it would have full bearing.

Representative PRICE. I agree with you on that point, Mr. Ellis.

Chairman ANDERSON. We could not sit here as a committee and direct them to do it. It must be a bill.

Mr. ELLIS. We agree with you that in substantive law there would have to be a direction, but we also note that many committees of the Congress substantially direct and that the result is action. Even Appropriations Committees write it into the language sometimes.

Chairman ANDERSON. I hope you would excuse us if we don't overstep our bounds.

Representative COLE. I think we can assure you, Mr. Ellis, that this committee has never directed the Commission to do anything. Whatever influence the committee has had, we have persuaded the

Commission to adopt certain policies rather than directed them to do it.

Chairman ANDERSON. I am not trying to quarrel with you, but the word is in here, and I thought it might be well to just point that out at this time. Go right ahead.

Mr. ELLIS. We simply cannot compete with the military for time and attention of AEC officials. To date the AEC has not established such a division. The AEC is directed to do so in section 25 (a) of the Atomic Energy Act of 1954. It is absolutely essential that such a division be established in order that more emphasis can be placed on civilian power. Perhaps this can insure a higher priority being assigned to the development of civilian atomic power. It would also enable all interested in such an objective to keep better track of the progress being made.

Also those interested in the development of civilian atomic power should be able to obtain more adequate technical assistance and know exactly where they can go for such assistance. The rural electrification program has always depended upon the Government for assistance of this type. On the whole the rural electric systems are too small and too poor to possess the financial and personnel resources to provide such assistance on their own. We believe a very healthy partnership is created between the Government and the people when the Government assists groups such as ours so they can better help themselves take advantage of this new resource in which the people already have invested over $15 billion.

At the present time at AEC there is a Division of Civilian Application. This Division is essentially regulatory and licensing in character and is not the dynamic organization we believe the McKinney panel had in mind to assume the leadership in the development of civilian atomic power. There is also the Civilian Power Reactor Branch at the AEC. This Branch is part of the Division of Reactor Development. It is very small and has about 9 to 12 men who although devoted to their work and willing to help certainly cannot accomplish the tremendous job which lies before us.

We also understand that from time to time this staff has been depleted by people leaving for private industry. In fact, we hear that 2 of the members of the staff have recently left, 1 to accept a position with a chemical company and another to accept a position with Ebasco. Ebasco is not among the friends of the rural electrification program. I am sure Ebasco is familiar to all of you because of its role in the Dixon-Yates matter. It is a shame that the rural electric systems will be denied the counsel of AEC personnel who leave for more lucrative positions in private industry and it is even more of a shame when some of them leave to work for the very organizations which are attempting to destroy the rural electrification program.

We hope this Joint Committee will not only take some action to direct the AEC to establish a Division of Civilian Power but also to insure that once that division is established, it can retain its personnel once their period of Government training is completed. I do not know the answer to this AEC personnel problem, but there certainly must be some answer.

Representative HINSHAW. Russia does that very satisfactorily, I am sure.

Mr. ELLIS. I don't propose to do anything the way the Russians do.

Representative HINSHAW. How do you do it, make them enlist and say they will have to serve?

Mr. ELLIS. No, sir. We don't know the answer. We think there are two things that could be done. This is my personal opinion. One is the salary range between AEC personnel and the salaries which the same people get when they go into industry. The variation is too great. That would seem to say if you are going to try to hold the top people in AEC, we are going to have to pay them more money. That is one thing.

Representative PRICE. Most of us agree with you on that point. We are gravely concerned over the problem you have just brought out. We share your concern in this problem.

Representative HINSHAW. We have some specific ones in mind because we lost some of our own staff for three or four times the amount of money we can afford to pay them. We cannot afford to pay them that salary in Government. The Government cannot do that without upsetting the entire pay scale.

Mr. ELLIS. Maybe the Government ought to consider trying to meet the market in some of these fields to hold them if it is necessary to hold them. That is one point, anyway.

Chairman ANDERSON. I will tell you when you try to do that, you will run into a situation at least in the House of Representatives, and I think in the Senate, where they are not in favor of trying to get up too far in this scale. I can give you a sample not related to atomic energy but an individual made an examination of a job in the Department of Agriculture at one time. We had a commodity branch that had an inventory just 70 times as large as the inventory of this man's personal business or private business. He paid his man who was in charge of this particular section $24,000 a year. We had 70 times the inventory that he had, and a great deal more complex records, and we were allowed to pay our man $8,000 a year. He just wanted to quit and go home. What are you going to do if along comes a very large organization and offers a man $50,000 a year? I know of an individual in the atomic energy program who has had three $50,000 offers in the last 2 years. He is still happily going along on his present salary. He said, "I am eating pretty well." I imagine as soon as the announcement came that Dr. Zinn had resigned at Argonne that he got some very interesting offers, because he is worth $100,000 a year, I imagine, in many businesses. But he was well satisfied to stay at a lower figure for a good long time. It is a very difficult problem if you try to meet it on the basis of meeting industry. It is a long, long story.

Mr. ELLIS. Yes, sir, we agree. One other thing we think might be considered, though—and we feel so strongly about this because we have spent too much of the time we have been at the AEC meeting some new man in a position where we just met somebody else not long before, and having to spend so much time in acquainting him with our program and getting his ideas, and letting him get acquainted with us—we think another thing that might be considered is a program similar to what the Government already has in operation with regard to its Foreign Service people. Let them agree to stay so long when they come in.

Representative HINSHAW. Just about that time, at the end of "so long" they become valuable. It is at the end of the period, and not the beginning of the period.

Mr. ELLIS. That is right. But some of them have stayed an awfully short time.

Representative HINSHAW. At the end of "so long" they are worth several times what the Government can pay them.

Mr. ELLIS. That is right, but usually they are in the process of moving up. They stay a while to do that. If in each new job they go into they agree to stay a certain time, there might be something worthwhile there.

Representative HINSHAW. If you want to really solve the problem for 30 years from now or 20 years from now, that is about the time you can solve it, you better start in the grade schools and high schools and start developing a surplus of these people that have all that knowledge. Then the prices won't be so high.

Mr. ELLIS. We fully agree on that. It is the law of supply and demand that is grabbing these folks away from us.

Representative HINSHAW. That is correct.

Chairman ANDERSON. Now that we have a field of agreement, could you try to put it out pretty fast?

Mr. ELLIS. Yes, sir.

We have been told our recommendations on a Division of Civilian Power are impractical because there are not enough trained technical people available. We realize that this is a tremendous problem and also a challenge. A nation with our resources certainly can solve this problem. But to do so will require an intensive program of Government financial assistance for training and research in our colleges and universities. We believe such a program should be started immediately and be continued on an expanded basis over a period of years. We understand Russia is laying great stress on such a program. Our members at their recent annual meeting endorsed such a program as the resolution included as Exhibit No. 3 shows.

We have heard the AEC discuss such a program and we understand it is taking some minor steps to implement it, such as making available to universities nuclear material and paying for fabrication and reprocessing of fuel elements, etc. There also has been some discussion of scholarships for worthy students pursuing courses which are valuable in the atomic energy field. We believe a national scholarship and fellowship program should begin immediately and also there should be a stepped up program to make available on the easiest possible terms as much material and equipment as necessary for research reactors in our colleges and universities. Such a program would benefit the whole country by giving thousands of young men and women the opportunity to obtain an education which they otherwise would not be able to get and in turn enable them to make a real contribution toward developing peaceful atomic abundance.

REA atomic power staff. We agree wholeheartedly with Recommendation No. 2 on page 17 of the section of the panel report entitled "Government Organization." I believe we can speak with some authority on this subject. For several years now we have urged REA to develop an adequate atomic power staff to keep abreast of the latest developments, to advise the REA borrowers of these developments, to work with our own study group and also to be prepared to review

any atomic power proposals which might be submitted by the rural electric systems to AEC and which would require some REA financing. Congress several times has appropriated funds for REA to set up such a staff. To date REA has not done so. To the best of our knowledge REA has only one man who is working full time on atomic power. This man is now attending the 7-month reactor training course at the Argonne National Laboratory. That is good as far as it goes. There are a few REA people who spend some of their time on atomic power, but most of these men have other heavy administrative responsibilities and therefore have little time to devote to atomic power.

We have been told by REA that it is unnecessary for them to set up an atomic power staff because they can receive necessary advice and assistance from AEC. AEC certainly does not have the personnel to devote to the specialized needs of other agencies. At least that it what AEC personnel tell us. Therefore we can wholeheartedly agree with the panel's recommendation—

> that other departments and agencies of the executive branch be encouraged to develop their own organizations for leading with their functional interests in peaceful uses of atomic energy, drawing upon the Commission for advice and services rather than leaning on the Commission or delegating their functions to it.

REA will be performing a real service to all the rural electric systems when this course is taken.

We disagree with the conclusion on page 16 of the section of the panel report devoted to patents which states:

> Return of patents on peaceful atomic applications to the normal system must be the objective.

We believe the Atomic Energy Act should be amended to provide for compulsory licensing of all atomic patents for an indefinite period of time, not just for the limited compulsory licensing of patents declared affected with the public interest by the Atomic Energy Commission. Most patents which can be obtained have some basis in the tremendous public investment in the development of atomic energy. Because of this, these patents should be considered a part of the public domain and available on equal terms to all who desire to use them. Also, since this technology is so new and can be of such far reaching importance, these patents should be made available to anyone who feels that he can contribute to furthering this development. We do not want anyone to be able to get in a position where he may be able to retard the development of this new great energy resource because its rapid development may conflict with his, or its, entrenched vested interests.

We agree with the panel's recommendation—

> that the Commission announce its complete interpretation of patent provisions relating to private development of peaceful uses promptly, not on a piecemeal or case by case basis.

The AEC has a great deal of discretionary power under the patent provisions of the 1954 act. Because of this it has an obligation to clarify how it is going to implement these provisions.

In conclusion, it is my opinion that the United States has no civilian atomic energy program worthy of the name; that other nations, including Russia, have achieved world leadership in atomic energy development; and that we need and must have broadening amendments

to the Atomic Eenergy Act and dynamic administration and leadership instead of the present inertia at AEC.

Representative COLE. Mr. Ellis, I notice all through your statement you have used the first person plural "we," which I assumed to be a sort of editorial use of the term. But here in this conclusion you say "It is my opinion." I am curious to know if that was just an oversight or a deliberate selection of words?

Mr. ELLIS. No, sir. That is deliberate, because this is stronger language. Therefore, I desired it to be stated in the first person.

Representative COLE. Previously you say "we believe" and "we recommend" and "we think this," and so forth. Is that voicing a thought of the association you represent?

Mr. ELLIS. I believe that the "we" used throughout pretty well represents the association position. I deliberately used the first person here only because this is a stronger statement.

Representatice COLE. Could it be then that by deliberately not using the word "we" to express the thinking of the association, that the association does not agree with your conclusion where you stated it is your personal opinion?

Mr. ELLIS. No, sir, I believe that the association would support all the statements I have made here. I believe that is the way they feel. Otherwise, I would not make it. But since they have not said, for instance, that the United States has no civilian atomic energy program worthy of the name, I wanted that to be my statement and my opinion.

Chairman ANDERSON. Proceed.

Mr. ELLIS. The development of civilian atomic power is really a part of our struggle the world over. All over the world men are awed with this great new energy resource which to many of them can mean a more abundant life, a life beyond their fondest hopes and dreams. We must prove to the world that we are capable of developing an atomic power abundance at home and that all segments of our economy have had a part in this development. We of the rural electric systems are ready, willing, and anxious to do our part in achieving this objective. Only if we achieve such an abundance at home and then express our willingness to share it with others the world over will we be able to win this intense struggle for the hearts and minds of men.

Let us have, for the civilians too, a real Atomic Energy Commission, not an Atomic "Energyless" Commission as at present.

Chairman ANDERSON. Without objection, we will include exhibits 1, 2, 3, and 4 at the conclusion of Mr. Ellis' remarks.

(The documents referred to follows:)

EXHIBIT 1

Whereas the future standard of living of our people and national security depend upon an adequate supply of low-cost electricity; and

Whereas private industry seems hesitant at investing money in the development of atomic enery: Now, therefore, be it

Resolved, That we urge the Congress to appropriate funds for the Federal construction of from 6 to 10 full-scale atomic plants to hasten the development of this great resource; and be it further

Resolved, That AEC and REA give all possible aid and assistance to any rural system seeking to construct an atomic plant.

EXHIBIT 2

ATOMIC ENERGY

Whereas the Attomic Energy Commission has failed to stimulate the development of experimental atomic powerplants by depending upon the complete financing of such experimental work and construction by large profit utilities and manufacturers; and

Whereas the interest of such profit utilities and manufacturers is for only large generators of over 50,000 kilowatts and too large to be valuable to municipalities, REA generating co-ops and public utility districts in high fuel cost areas; and

Whereas the intentions of Congress for achieving rapid development of the use of the atom for producing electric power has made no progress toward the actual construction of such experimental powerplants suitable for small size operation; and

Whereas the directors of rural electric cooperatives, and public utility districts have demonstrated their ability and qualifications to quickly and economically complete the electrification of rural America and would give the same untiring effort and high integrity to the rapid development and use of atomic power: Now, therefore, be it

Resolved, That Congress immediately make available sufficient funds for AEC, under a mandate, that such funds are to be made available to municipalities, rural electric co-ops and public utility districts for the development and construction of experimental nuclear reactors of various types up to 50,000 kilowatts.

EXHIBIT 3

ATOMIC ENERGY PERSONNEL

Whereas the Atomic Energy Commission has alerted the Nation to the lack of training facilities and shortage of engineers and personnel for maintaining the development and research of atomic energy uses and that such personnel are urgently needed in the future to maintain the Nation's leadership in world affairs; and

Whereas Communist nations are presently leading in the training of such specialists and may rapidly equal and surpass the number of qualified people in the United States: Now, therefore, be it

Resolved, That the Congress provide funds for installing facilities, providing instructions and other incentives necessary to make qualified personnel available to the atomic energy industry and research activities and to insure the military leadership in this field.

EXHIBIT 4

ATOMIC ENERGY POWERPLANT IN TENNESSEE VALLEY AUTHORITY

Whereas the Atomic Energy Commission is constantly requiring large additional blocks of power from TVA and Bonneville Power Administration and the Commission is charged with the development and improvement of the use of the atom for electric power production: Now, therefore, be it

Resolved, That the Atomic Energy Commission and the Congress provide funds for constructing large atomic energy powerplants in the TVA and the northwest areas for the purpose of supplying requirements for the Atomic Energy Commission and developing the use of atomic electric power production.

Chairman ANDERSON. Do you desire to incorporate the statement of Mr. Cochran here. The time is short. If you do not mind, Mr. Cochran, we will include it at this point.

Mr. COCHRAN. Mr. Chairman and gentlemen of the committee, in a sense, we are grateful to the McKinney panel for at least recognizing that the accelerated tax-amortization program (conducted under the old sec. 124–A of the Internal Revenue Code, and currently conducted under sec. 168 of the Revised Code) is a significant

factor in the development of atomic energy by private corporations. In a series of discussions with various AEC officials we have never felt we were successful in getting them to recognize that the ability of the private power companies to get acceleration certificates added to the difficulties of nonprofit electric systems in participating in this program.

AEC has tended to take the view that it has the responsibility for getting this development program done with the least possible cost to AEC. We have taken the view that economy was certainly a factor, but that economy was a broader concept than the bookkeeping apparatus of AEC and that whether or not a deal on a reactor was the most economical to the Government should include consideration of the probability of tax subsidies via accelerated amortization.

There is no doubt that in the years ahead, as long as the Congress permits DEPA and ODM to, in effect, appropriate funds from the Treasury as subsidies to private power companies that this will give those companies a financial advantage in entering the atomic energy field. It is with this in mind, as well as our feeling that the program is dragging unexcusably, that we have continued to insist that the Congress, through AEC or some other agency, should push development by direct Federal expenditure for Government-owned plants as well as in the form of subsidies to all groups interested in participating in the program.

I would like to point out to this committee that the private power companies, from June 1951 through January 25, 1956, have already been granted certificates which will net almost $1.2 billion in interest-free loans and over a period of 33⅓ years will net them a subsidy of over $4 billion. If the applications for additional certificates at ODM are approved on a basis roughly comparable to past grants the total interest-free loans will amount to about $1.7 billion and the total subsidy to $5.6 billion. Contrast these sums with the total REA loans to the rural electric systems of around $2.7 billion and you realize the situation we face in participating in this program.

I would like to add, parenthetically, that a great many people are increasingly curious as to why the Congress permits three full-time DEPA employees with their power company consultants to, in effect, appropriate these tremendous sums out of the Treasury without advance notice to the Congress, without any detailed justification as to the necessity from a defense standpoint, and with the obvious consequences to the economy of providing interest-free capital to a prosperous and highly monopolistic industry, while at the same time expenditures for Federal power development have been drastically cut.

Chairman ANDERSON. If there are no additional questions, thank you very much.

Chairman ANDERSON. Our next witness is Mr. Elliott Earl.

STATEMENT OF ELLIOTT EARL, PARTNER, WILSON & EARL, MANAGEMENT ANALYSTS, POWER CONSULTANTS, SHERATON CORPORATION OF AMERICA, BOSTON, MASS.

Mr. EARL. If it please the committee, my name is Elliott Earl. It is spelled with two l's and two t's; and no "e." I was born in Bangor, Maine, and am therefore a citizen. I am the principal partner and owner of a small consulting management firm with offices in Man-

chester, Conn.; Boston, Mass., and Bahia, Brazil. The other partner of the firm of Wilson & Earl, is buried in the Adjuda Cemetery in Porto Seguro, Brazil, where he died in an airplane accident in 1950. At the time we were trying to improve the quality of Bahia cocoa, and operating in the power, timber (tropical), and transportation business. Had I had this article before making any commitments which is in the February 1956 Atlantic, I think we might never have gone to Brazil. In any event, we were operating in the power, timber, and transportation business in Brazil, when my partner passed on.

The nature of the services that this particular company that I am a principal partner of performs is very brilliantly set forth by the United States Air Force in this operational Air Force manual called, 170–2, "Management analysis." It is one of the best dissertations and explanations of management analysis I have ever seen. It is a beautiful job. The Atomic Energy Commission might benefit by just glancing through it. They really might. This manual points up our troubles. The problem is one of skillfully using men, money, and machines to get atomic hardware as fast as we can. That is what our problem is.

This manual gives you an idea how the Air Force gets airplanes fast. We might profit by an application of those principles to the atomic energy situation.

I have worked for various interests and parties at interest in the public utility power and light business, including the rate-paying public, organized labor, investors and financial interests, management, and Government in its regulatory aspects. In 1935 as a commissioner and vice chairman of a Massachusetts commission, I helped to peg the so-called Massachusetts prudent investment theory of public utility rate regulation—interestingly, by studying the Washington, D. C., sliding scale plan, which has recently gone on the rocks, and which we predicted in 1935 would ultimately go on the rocks, if the system did not work both ways. During World War II, I served on the staff of the Chief of Naval Operations, in the Office of Naval Intelligence as the Officer in Charge of Industrial and Personnel Security, later as personnel auditor of the United States Naval Intelligence Service, and still later as an engineer officer on board the aircraft carrier U. S. S. *Wasp*.

As personnel auditor of the Naval Intelligence Service, I was assistant to Adm. Ellis M. Zacharias, who was at the time Deputy Director of Naval Intelligence.

Adm. Alan G. Kirk, our former ambasador to Russia, and a former Director of Naval Intelligence credits me with the authorship of the personnel security questionnaire which is used by the Department of Defense and Atomic Energy Commission for granting consent for access to secret, confidential, and atomic restricted data.

I have recently, gentlemen, got one of my own ideas wrapped around my neck.

Chairman ANDERSON. It is as good a place as any to wear it.

Mr. EARL. I know. Sometimes it is not good to have some of your own ideas thrown back at you, particularly when some of the key moves in connection with these ideas are left out.

The security quetsionnaire is used by the Department of Defense and Atomic Energy Commission for granting consent for access to secret, confidential, and atomic restricted data.

One of my fellow associates in Naval Intelligence was Judge Robert Morris of New York, who, thankfully has resumed his very important work on the Senate Subcommittee on Internal Security, one of the most heartening things that has happened for a long time. Judge Morris understands his subject, communism, and the internal security of the United States. Judge Morris was stationed in New York, I in Washington.

Since the security problem seems to be so difficult for this committee and the Commission, and there seems to be such a wide difference of opinion, for whatever it is worth, it seems to me—and now I address my remarks to Representative Kilday—having just gone through the agony of getting an access permit and being cleared, which took roughly 1 year, or perhaps I had better be more precise——

Representative COLE. Why do you single out Congressman Kilday?

Mr. EARL. As I understand it, he is chairman of the Subcommittee on Security.

Chairman ANDERSON. We do not care whether it is 1 year or 10 months. It is close enough.

Mr. EARL. It says here about 9 months in this file.

So I think the situation could be improved a little bit.

The Commission has announced that more than 600 firms have been granted access permits. A much more significant figure would be the number of people cleared. Last Friday, Dr. Libby gave us that information, and it is 16,500.

If I may presume, I would like to ask the committee a simple question. Is this adequate? 16,500 people having access to the key information that we need in order to develop atomic power?

But I did not come here today to talk on security matters. I would like to address our thinking to a much more serious problem, and that is the problem of the shortage of trained and skilled technicians for atomics and what it is proposed we will do about it.

I might say in passing, and I am a Republican, that I agree with Senator Anderson on the security problem. It ought to be improved.

Representative PRICE. You did not have to bring that out. If you had not said it I would not have been able to tell it.

Mr. EARL. I know it.

Representative COLE. Why spoil what might otherwise be a good statement?

Mr. EARL. I am sorry.

Representative HINSHAW. You mentioned your client, sir, but you did not mention his name.

Mr. EARL. Yes, sir.

Representative HINSHAW. Who is it?

Mr. EARL. The Sheraton Corporation of America.

If the situation could be improved it would be of tremendous benefit to American industry, and foreign nations who have entered into bilateral agreements with us, under the President's Atoms for Peace Program.

At this point I would like to say that there has been a lot of loose criticism of the AEC. I think it is not merited. I know of no other governmental agencies who have had the problems comparable to the Atomic Energy Commission, who have performed in such an admirable fashion. In this connection—security—I should like to say there is one man that has stood like the Rock of Gibraltar in connection with

the security of this country. It has been Captain John Waters, Security Officer of the Atomic Energy Commission. I thank God we have had him in that spot.

But, to continue with my qualifications to appear before this committee, I was trained at the taxpayers' expense at the United States Naval Academy with the class of 1929. I resigned just prior to graduation due in part to football injuries received in the fall of 1928 while I was captain of the B squad, sometimes referred to as the gun fodder for the A squad.

In 1929–30 I was a manufacturing student engineer at the General Electric Co. in Lynn, Mass. One of my classmates who stayed with the General Electric Co. is the present vice president in charge of that company's atomic products department, and as a result I, of course, carry stored atomic power around with me in my pocket. (SIR medallion and alnico piece held up.)

I am the author of an analysis entitled "Prudent Investment in Atomic Power" which some of you may have seen. I have sufficient copies of that analysis for each member of the committee, which I have handed to the clerk for distribution. It cost $8,000 to prepare. Since that analysis carries a full description as to my background and connections, I will, if it pleases the committee, pass any further comments on myself.

I might say in passing that I am a qualified professional educator holding a master of education degree from Boston University, so, if I should in this matter which I would like to discuss with the committee—namely, the shortage of technical manpower in the atomic energy field, and particularly as it relates to the so-called technician level—adopt the usual lecturing attitude, which was so classically demonstrated by Dr. Libby last week, please forgive my inexperience, and credit my enthusiasm for the President's great concept as set forth in the Atoms for Peace Program which he laid down before the United Nations—how many years ago? Two? Three? Wasn't it December 8, 1953? Wasn't his language quite plain? It is a great state paper of a great man. We have been neglectful in carrying out his suggestions.

That is why I am here. First, as a citizen petitioning my Government; and, second as a professional power consultant and management analyst with an idea as to how to improve the situation. In any event we are going to do something about it and I thought you might be interested, and, of course, I speak only for myself and our clients.

I appear today as a result of some correspondence with the committee itself, and the staff of the McKinney panel, and in particular my registered letter No. 3011, addressed to Mr. George Norris, and mailed on February 6, 1956, from Manchester, Conn., which letter contained a copy of our suggested program Technicians for Atomics, and a copy for each member of the committee, it being one method of attack on the serious problem of the lack of trained and qualified technicians to bring about the objectives of the President's Atoms for Peace Program.

In discussing this program with the Commission's staff and members of this committee and its staff, we have arrived at a point where there is a considerable divergence of views as to its relative merit. Since we have heard of no program sponsored by the Commission at this particular level, and the rather unique manner of teaching which

we are advocating, we were invited to appear here today to present our thoughts and views on this problem to the committee. I shall not clutter the record with cross references to either Prudent Investment In Atomic Power or Technicians for Atomics, but, rather, shall simply explain how we are now planning to work the program out in practice. If the committee wishes to incorporate both of the above documents in the record, as a matter of record, I have no objection.

It may be of interest to the committee as to when this idea was generated and how its practical application came about.

In 1941 I had official duties which brought me in close contact with Dr. Vannevar Bush, then head of the National Research Defense Committee, and the successor organization, the Office of Scientific Research and Development. As you may recall, Dr. Karl T. Compton, late chairman of the board of MIT, had much to do with the work of these organizations, and since prior to my service in the Navy Dr. Compton and I had served together on a Massachusetts regulatory committee (public utility) we were perhaps familiar with each other's views on a number of things, including atomic energy

He suggested then that I should familiarize myself with its peaceful power making potential, repeated it again in 1944, and asked me again in 1954, what I had done about it just before he passed on. All I could reply was that I had been thinking about the subject, studying everything I could lay my hands on, and with the passage of the Atomic Energy Act of 1954 was prepared to do something about it, roughly as outlined in the Technicians for Atomics brochure, as preceded by the analysis Prudent Investment in Atomic Power.

Dr. Compton thought my pattern of attack on the problem made sense, and urged that I carry out my plans. Because of my deep devotion to him, and keen appreciation for his great wisdom, I am doing as he urged.

If you have familiarized yourselves with the contents of Technicians for Atomics, you know that it is a more or less conventional so-called "in plant, at site" home study orientation and training program for key men and middle management aimed at the provision of the needed technicians for atomics which are not now available to industry, and at reasonable cost to the Government and industry, in terms of effort, and money. We think such a program will help to provide atomic power hardware.

For some time now I have been suveying American industry for a likely place to start a pilot operation. The result of our survey is contained in status reports Nos. 1 and 2, previously furnished the committee. So much for background.

Last September, the international and commercial aspects of Atomic Energy were the subject of discussion at the Atomic Industrial Forum, Inc., which was held at the Sheraton Park Hotel in this city. I am a member of the forum and attended the conference not only as an active participant in some of the discussions but as a long-time associate and sometimes consultant of the principal management of the Sheraton Corporation of America whose hotel management acumen has permitted them to make a profit in the hotel business where others have failed. The Sheraton Corp. presently operates the Sheraton Park in Washington.

In September of last year Mr. Moore, who is the executive vice president of the Sheraton Corp., and I, discussed the possibilities of

atomic power for the Sheraton Corp. It was pointed out that because of his increasing costs for air conditioning, heat, light, and power, it might be worth investigating fully.

I am here now to report that we have made a preliminary study of the possibility of utilizing atomic power for light, heat, power, and air conditioning the Sheraton Park Hotel.

Further, I am glad to report to you today that we have been commissioned to make a full formal feasibility study of the use of atomic power for light, heat, power and refrigeration and air conditioning for the Sheraton Park right here in your good city of Washington.

Thus the training, retraining, and education and security problems connected with atomic power are quite practical for me as an individual.

Generally, I think there is no reason why we should not start a study of this kind. Where it will lead, I do not know. However, in this study it is our hope that we can work cooperatively with the AEC and the manufacturers of atomic power equipment and perhaps with Potomac Electric Power Co. I think there has been altogether too much name-calling in this business. I think what we ought to try to do is to work as a team to get atomic power as fast as we can, either in small or large sizes.

I might say this, the reason we have selected Washington is because the rates for power for the Sheraton Park Hotel happen to be about the lowest in the country. If our analysis shows that it is prudent to invest in an atomic power plant for this property, there are several other Sheraton properties.

Chairman ANDERSON. You have me a little confused there.

Why did you pick the lowest rate instead of a place where rates might be high and therefore atomic power might be more readily usable?

Mr. EARL. We want as wide a spread as we can get.

Chairman ANDERSON. You want to show something.

Mr. EARL. Exactly, we want to show something. We want the minimum and the maximum.

We think there is enough information available from our preliminary study of this situation, which, as I say, extends over a period of about 12 years, there is now enough information available, Senator, which has been declassified and which I have access to under an L classification—not a Q—which will justify the expenditure of whatever funds are necessary to make this study. We think that from that information, that a low power package reactor plant, a contract for which has just recently been let to Argonne for the design of such a plant to the pioneer group in Chicago—I am talking about the homogeneous small low power plant—might be very interesting to us.

Of course, one of the toughest nuts to crack now in connection with this thing, as far as my job is concerned, is the manpower problem. Where are you going to get qualified operators? How are we going to qualify these men to hold an operator's license?

Gentlemen, as a former engineer officer of the *Wasp*, I think there is an awful lot of baloney in connection with this atomic power thing. We ran at pretty nearly full power, 135,000 horsepower, which is 100,000 megawatts, for a matter of a hundred days while on board

the *Wasp*. I think that you will infrequently, in public utility operational service be faced with such conditions.

As far as I am concerned, a reactor is another kind of a boiler. We had eight boilers on the *Wasp*. If steam can be generated in those reactors cheaper than it can be by the most advanced type of combustion engineering in use today, then we ought to get on with the job of getting it.

Now, before the Russians beat us to it, I mean. They appear to be doing just that. I cite as references—I do not know whether you have seen this or not—it is well worth a glance. This is the National Science Foundation's study of Soviet professional manpower. I would invite your attention particularly to chapter 3 at page 69 and at page 84 in connection with what I am talking about.

Of course, it is going to take us a little time to get the technical know-how for these people. However, it does not seem to me that the people that are being graduated from Argonne or Oak Ridge are going to be satisfied with a job as a powerplant operator at the Sheraton Park Hotel. I am getting very practical. Nor would they be satisfied with a job as a boiler tender or water tender in the Navy. That is the problem that we are faced with.

I have made it quite plain to the Commission that we think there is room for another type of education and training in connection with atomic energy, and that such a program would be a satisfactory reply to the Vice Chairman's inquiries last week, when he raised the question, what are you doing about the technician-level fellow? You remember it well, I think, Mr. Chairman. Dr. Libby was not responsive or he did not understand the question.

Our notion is that now we intend to take this Sheraton Park situation as a case study. We will run a series of lectures or something, seminars and conferences, on it. We will call it perhaps the Institute for Atomic Technicians with the specific objective of formally examining the possibility of the use of a relatively small LPR reactor or battery of them for the hotel. By so doing we will come up with accomplishing two worthwhile objectives. First, we will orient a number of technicians who will be invited participants to attend the institute, which we hope will be jointly sponsored by the parties at interest to the technical aspects of the Atomic Energy Commission's civilian applications program, particularly as it may relate to power, that is, manufacturers, and the power industry as well as ourselves.

Second, we will come up with our formal analysis and report of the situation as the work of that group.

In this way the participants will learn by doing. They will have very specific phases of the study assigned to them. If they are at all familiar with us, I am sure they will get the right answers, or at least insofar as we may be able to get them from the Commission.

In concluding, if it pleases the committee, I should like to congratulate whoever originated the bill for atomic power for the Capitol and to commend the chairman and Representative Cole for introducing the bill into Congress. It should pass.

I hope if the Congress ever creates a Congressional Medal for Peace, which seems to be a worthwhile thing to do, in connection with realizing the objectives of the President's atoms-for-peace proposal, I hope the administering agency of the Government will realize the real contribution made by Adm. Earle Mills who thought up the idea of the

atomic powerplant to make a real submarine and was able to push it to successful conclusion through the able execution of Admiral Rickover in the *Nautilus*. Sometimes, gentlemen, we are weak in using a great force and that is recognition and appropriate commendation in the cause of freedom.

In my quarter century of reading, reviewing and writing reports for management of American industry, I have seldom read as well structured or evenly presented report as that of the McKinney panel. I hope you will give their recommendations full consideration, and add to those two rather simple ones of mine. They are: to strengthen your Subcommittee on Security and give it an adequate staff to study the subject with a view to improving it, and, second, create a Subcommittee for Manpower and Education and study that subject with a view to improving that situation.

It seems to me that both would be in the interests of all of the people and their investment in atomic energy.

I am very thankful to you, gentlemen, for listening.

Chairman ANDERSON. Thank you.

Are there any questions? If not, I said I would read the letter from Mr. Searing. It is dated February 14, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy, Washington, D. C.

DEAR MR. CHAIRMAN: Thank you for your invitation to testify in the hearings now being held by the Joint Committee. I shall be very glad to appear if the committee thinks it desirable. I believe however that this letter may serve the purposes of the committee.

I have read with interest the report of the committee's panel on the impact of the peaceful uses of atomic energy. The panel has brought into clear focus the many factors and problems connected with the peaceful development of atomic energy.

When I appeared before the committee on February 10 last year, I indicated that the chief interest of Consolidated Edison in atomic energy was in utilizing it for power. I said that our first objective was to get a program underway and along that line announced our intention to apply for licenses to construct and operate an experimental atomic reactor. This we did on March 22, 1955. You know of the progress and status of our application from the report of the impact panel (vol. 2, pp. 737–738) and the testimony of Mr. Harold Price before your committee last week.

I believe we are carrying out the intention expressed last year to get something done. Preliminary design and development work has proceeded satisfactorily and within the allowances made in our original schedule. We have already obtained expert analyses of hydrological, geological and seismological conditions at the site selected for the reactor in Westchester County. New York University now has underway a study of meteorological conditions. Within a few months our supplier, the Babcock & Wilcox Co., will initiate experiments on a full-scale reactor core to verify calculations of performance characteristics of the reactor.

We are now discussing the terms and conditions of a construction permit with the Commission staff. Both we and the Commission have recognized that a program such as ours must be evolved in an orderly way, with thorough evaluation of the technological and regulatory problems presented.

We are, of course, giving major attention to the safety features of our program. By the time our reactor goes into operation, I hope and believe that the results of experimentation by ourselves and others will lay a solid foundation for evaluation of operational hazards.

There are many matters yet to be worked out. One example is the need for a private reprocessing industry. We are proceeding on the assumption that this and other collateral problems will be solved as developmental work continues on a broad front. In that connection, we were glad to note the recent announcements of the progress being made by the insurance industry toward providing necessary coverage of atomic hazards.

I should be happy to have this letter inserted in the record of the hearings if you think it appropriate.

Respectfully yours,

(Signed) H. R. SEARING,
Chairman of the Board,
Consolidated Edison Company of New York.

Chairman ANDERSON. Mr. Pickett.

STATEMENT OF TOM PICKETT, EXECUTIVE VICE PRESIDENT, NATIONAL COAL ASSOCIATION

Mr. PICKETT. My name is Tom Pickett. I am executive vice president of the National Coal Association, with offices in the Southern Building, 15th and H Streets NW., Washington, D. C. The National Coal Association is the trade organization of the bituminous coal mine owners and operators whose total production is two-thirds of all the commercial bituminous coal produced in the United States.

The coal industry has a deep interest in the progress of atomic energy, both from the standpoint of its military potential and the peaceful applications. The association has reviewed the principles involved through a committee established for that purpose. The committee is composed of the following: Kenneth A. Spencer (chairman), president, Pittsburg & Midway Coal Mining Co., Kansas City, Mo.; Joseph T. Berta, president, Pittston Clinchfield Coal Sales Corp., New York City; L. Russell Kelce, president, Sinclair Coal Co., Kansas City, Mo.; R. H. Knode, chairman of the board, Stonega Coke & Coal Co., Philadelphia; George H. Love, president, Pittsburgh Consolidation Coal Co., Pittsburgh; A. R. Matthews, president, Pocahontas Fuel Co., Inc., Pocahontas, Va.; M. L. Patton, vice president, Traux-Traer Coal Co., Cincinnati; and R. E. Salvati, president, Island Creek Coal Co., Huntington, W. Va.

As a result of our committee's study, the board of directors of the National Coal Association on November 1, 1955, adopted a resolution setting forth the policy of the coal industry on atomic energy.

At the outset, it should be made clear the coal industry recognizes the need to continue the development of nuclear energy under Government sponsorship. We recognize that in the anticipated growth of the Nation and rising demand for energy, all sources have a very important part to play, including coal, oil, natural gas, and atomic energy if it is developed to the point of economic feasibility under our free-enterprise system. There are many unsolved problems in the field of energy other than in the nuclear program. They should be given their proportionate share of consideration and research by the Government.

The resolution above referred to is as follows:

Be it resolved by the directors of the National Coal Association, That the following facts and principles should be considered by the executive branch of the Federal Government, the Members of Congress, the Atomic Energy Commission, and the American people, in determining the role of the Federal Government in the development of atomic energy:

I. In the progression of humanity, in furthering world trade, in advancing the cause of peace, and in maintaining the world leadership of the United States, there is a need to continue Government sponsorship of the development of nuclear energy. To this end, the National Coal Association recognizes the need for the Government to support the national laboratories and to carry out the basic as well as applied research in the field of atomic energy.

II. Future development of economically feasible nuclear power is necessary to provide power for underdeveloped areas of the world, to assist nations which have power shortages, and to protect the future of the United States in the power field. The National Coal Association therefore recognizes the need for the Government to continue the power-demonstration program to optimize the conditions under which atomic power is generated.

III. The public interest requires that atomic energy be utilized principally in whatever ways or processes it will contribute efficiently to the energy requirements of the United States and the world. The conversion of solid fuels to gas and to liquid fuels through the utilization of atomic energy promises great benefits to the people of the United States. The national laboratory effort should be directed toward minimizing atomic energy fuel processing costs, increasing the safety of reactor systems against the public hazards, and developing high-temperature materials of construction to the end that all sources of energy will receive their fair share of the total effort to achieve progress.

IV. The United States is one of the few nations of the world blessed with sufficient reserves of fossil fuels to meet the Nation's power requirements at low cost for centuries to come. In the United States the most economic source of steam-generated electric power in the foreseeable future will be plants fueled by coal, oil, or natural gas. Under the competitive stimulus of our free-enterprise system, the ingenuity of the American people will bring about the most beneficial results that con be obtained from all energy sources, including coal, oil, natural gas, and atomic energy.

V. The public interest demands dissemination of actual cost information with respect to nuclear fuels to the greatest extent compatible with national security. To the extent that Government subsidies are necessary in the development stages of the nuclear program, the public should be informed as to the magnitude thereof. There can be no reliable forecast of the comparative costs of power generation until nuclear-fuel costs, and the cost of the safe disposal of radioactive wastes, are established.

VI. The Nation's best interests are not served by unwarranted optimism about the early availability of low-cost nuclear power.

The reading of the resolution reveals in itself that the coal industry is in agrement with some of the conclusions and recommendations contained in the report of the Panel on the Impact of the Peaceful Uses of Atomic Energy. We have scrutinized the report of the panel and we believe it contributes a great deal to the public knowledge about present and prospective energy supplies and requirements.

One outstanding contribution to the public knowledge resulting from the report of the panel is the focusing of attention on the expected vast growth in energy demands and the part which the coal industry must play in meeting these demands. The public must also be made aware of the importance of coal and the capital outlay required for expansion to meet that vast growth in demand.

The report and its background material show that the Nation will rely on the coal industry for a large share of its increased energy supplies. They include figures furnished by the United States Bureau of Mines showing that by 1980 the Nation will need as a minimum 784 million tons of coal (nearly double the amount produced in 1955). The figures further show that by 1980 the Nation may need in excess of 1 billion tons of coal per year. These estimates are based on the assumption that synthetic liquid fuels will not be required during the period under discussion. When coal needs to be converted into synthetic liquid fuels to supply requirements for that type of energy, the demands on coal will be much greater.

The increasing demands for energy raise the question of whether there are adequate reserves of fossil fuels to meet the requirements. The facts furnished by the Bureau of Mines show the United States has nearly a trillion tons of economically recoverable bituminous coal. That is enough to last a thousand years, even if we are called upon to

double the current rate of production. Further analysis of figures supplied by the Bureau of Mines shows that approximately one-fourth of those reserves are "recoverable at or near present costs" (enough to last nearly 500 years at the current rate of production). Again, the Bureau of Mines figures show nearly 300 billion tons more of those reserves (enough to last an additional 500 years at the current rate of production) could be recovered at from 1¼ to 1½ times present costs. There is, therefore, an ample supply of bituminous coal to furnish the energy demands of our industry not only for the quarter of a century within the purview of the panel report but for the next millennium.

We not only have the coal—we have the ability to produce it. The production record through two world wars and that in Korea is evidence of that ability. The progress achieved in the last 15 years is further reassuring evidence that the Nation can rely upon the coal industry for its energy demands. In 1940 only 35 percent of underground coal production was mechanically loaded, and national productivity averaged slightly over 5 tons per man per day. At the present time more than 82 percent is mechanically loaded and national productivity averages 9 tons per man per day.

The panel report recognizes that where mining conditions are favorable, production reaches 20 tons per man per day for underground mines and 40 tons per man per day for strip mines. The Bureau of Mines estimates that national average productivity will increase to 15 tons per man per day by 1980. Mechanization in all phases of coal mining is increasing at a steady rate. The Bureau of Mines states that—

> Significant developments are expected in all phases of the coal economy, including mining, transportation, improvement in present utilization, and in new or expanded uses.

Kenneth A. Spencer, chairman of the National Coal Association's Atomic Energy Committee, in his statement before the panel on the Impact of the Peaceful Uses of Atomic Energy, stated the following:

> The Bureau of Mines quite properly sees improved mining equipment for underground, strip, and auger type mining, also improved methods of transportation, such as conveyor and pipeline systems, all of which will increase the economically recoverable reserves of coal. There are, however, other developments which will further enlarge recoverable reserves and reduce the delivered British thermal unit cost of coal. Substantially improved methods of preparation make possible the utilization of coal which was previously not commercially salable. The recent introduction of new low-cost explosives has substantially reduced that important cost of strip mining, thereby affecting both total mining costs and reserves which can be mined. The development of new processes in which coal is simultaneously used as a source of fuel and raw material, such as the low temperature char projects, make feasible integrated operations on previously unusable reserves of lignite.
>
> If we look down the road 25 or 50 years as we are doing in this atomic energy study, we will, no doubt, see the commercial development of coal gasification at the mine and perhaps the underground gassification of coal. All these factors will tend not only to increase recoverable reserves, but also reduce the delivered British thermal unit cost, particularly to utilities.

We concur in the panel's recommendation that—

> the Commission recognizes that military requirements for uranium are the present reason for ore price guaranties and that a free market should be the objective for the area of expanded peaceful uses without guaranties.

We endorse the panel's recommendation that—

> the guaranteed price schedules for the production of special nuclear materials should be declassified to make possible public examinations of this important financial device.

We agree with the panel that—

the inherent requirement for less secrecy and freer flow of significant information concerning the peaceful uses of atomic energy is greater than the encourabements to this end contained in the 1954 act.

The panel deserves to be congratulated for its contribution to the public knowledge about the benefits to humanity which are possible of attainment from atomic energy in such fields as agriculture, food preservation, medicine and health, and industrial processing. Obviously research in those fields should be the subject of intense effort. We note that progress in these fields is not dependent upon progress in the power field—the panel report contains a statement that the practical limit of radioactive products which science, medicine, and industry can absorb—

will probably be much less than the annual fission waste from a single power reactor, such as is now being constructed at Shippingport, Pa.

As set forth in our policy resolution, and as indicated in what has heretofore been said today, we agree with the panel in its conclusion that there is a need to continue Government sponsorship of the development of nuclear energy, for the progress of humanity, for furthering world trade, for advancing the cause of peace, and for maintaining the world leadership of the United States.

We do, however, find ourselves in disagreement with some of the overoptimistic and too enthusiastic interpretations, implications and conclusions drawn from language in the report, as well as some of the inferences deduced therefrom. For example, we cite those portions of the panel's report which imply that there is an urgent need for the development of nuclear power to meet the domestic energy demands. In this respect, portions of the panel's report are inconsistent with other portions. On the one hand, it leaves the impression that the development of nuclear power is necessary to maintain our expanding economy, and states that there is urgency associated with—

the need for establishing atomic energy as a power resource available to assist in maintaining maximum expansion rates of our economy.

On the other hand, the report recognizes that—

There is no current urgent need for new sources of fuel for the production of electric energy.

Again, the panel report raises the question of the ability of the coal industry to increase production, while at the same time it recognizes the ever-increasing productivity of the industry which is predicted to continue. A resolution of that question may be achieved by reference to the facts as set forth on pages 4 and 5 of this statement.

The report points out that—

The growth of electric power expresses in one simple index the American miracle of productivity and living standards.

and it recognizes that growing energy demands must be fully met in order to sustain a dynamic and expanding economy. It contains a forecast that United States total electric generating capability will grow from 103 million kilowatts in 1954 (it was in excess of 113 million in 1955) to somewhere between 358 and 600 million kilowatts in 1980.

We commend the panel for its selection of the growth of electric power as a simple index of the American miracle of productivity and living standards. The record of the electric utilities for uninter-

rupted low-cost power was made possible by the coal industry's ability to deliver British thermal units on a dependable schedule where needed and at costs competitive with those of other fuels in the most populous areas of the United States. As to the future, I quote again from Mr. Spencer, who stated to the panel:

> It is the considered judgment of the leaders of the coal industry that we will be in a position to supply fuel for the growing electric energy needs of the United States, at a reasonable cost for many, many years to come.

If the most optimistic hopes of the nuclear power enthusiasts are met, the Bureau of Mines figures show that in 1980 either 552 million or 938 million tons of coal will be required to meet the Nation's energy needs, depending upon whether the low or the high forecast of electric generating capability materializes. It should be noted that the optimistic forecasts quoted by the panel would have nuclear power generating less than a quarter of the Nation's electricity in 1980. These statements emphasize the Nation's long-range dependence upon coal as the primary source of low-cost power. We believe some atomic generated electricity may help supplement coal in supplying the Nation's needs for that energy. We believe atomic energy will neither destroy the coal industry nor reduce the Nation's need for a strong, healthy coal industry with a maintained capacity that can be expanded to supply enough fuel to sustain a dynamic and expanding economy.

Chairman ANDERSON. I certainly agree with that statement and I am happy to have you make it.

Mr. PICKETT. Thank you, Mr. Chairman.

The public should be informed as to the magnitude of Government subsidies which are considered necessary in the development stages of the nuclear program. We do not object to these subsidies under the power demonstration program while atomic power is still in the development stages. However, we do wish to point out that vigilance on the part of the Atomic Energy Commission and your committee will be required to prevent abuse of the authority to subsidize the development phase of nuclear power. AEC Chairman Lewis L. Strauss illustrated this point in a speech delivered by him on November 9, 1955, when he said:

> The information paid for in this manner must, of course, be new information which will supplement existing knowledge, otherwise it cannot be said to contribute to the advancement of the art. This means that the Government, generally speaking, will not invest in projects which appear to duplicate each other. Under this philosophy the Commission could not justify giving financial assistance to research and development work on 2 or 3 reactors which are of the same type and size, and which, therefore, could be expected to produce the same or very similar data.

On February 9, 1956, Chairman Strauss announced that the AEC had accepted, as a basis for negotiations, the Yankee Atomic Electric Co.'s proposal to construct, with Government subsidy, a pressurized water reactor plant. Mr. Strauss said,

> Research and development work to be done for this plant would supplement work required in the development of the pressurized water reactor, a plant of the same general type, which is being built at Shippingport, Pa., in a project jointly sponsored by the Commission and the Duquesne Light Co.

We don't know whether the Yankee Atomic plant is sufficiently different from the Shippingport plant to warrant government subsidy. We do say, however, that your committee and the Atomic Energy Com-

mission has an important task in seeing that a government-subsidized plant does not essentially duplicate a previous plant. If this task is not adequately performed, the program to subsidize development of the nuclear program could be converted into a distortion of our free enterprise system.

In the coal industry's policy resolution, we take the position that—

> The Nation's best interests are not served by unwarranted optimism about the early availability of low-cost nuclear power.

We are pleased to note that the panel report brings this matter into sharp focus. The panel feels that a better-informed public opinion, stabilized in the framework of sound public policy, is necessary to provide a balance to special-interest pressures. The report states that—

> The public attitude which now exists could result in the Commission's being charged with delaying accomplishment of the full benefit of peaceful uses of atomic energy—

a charge which the panel feels is completely unjustified. We concur with the report on this matter.

An informed public opinion with respect to atomic power is vital in many ways. For example, the report states that among the factors which may accelerate or retard the growth of nuclear power is—

> the possibility of extensive programs for the construction of publicly subsidized or publicly owned nuclear power plants.

If the public is given all possible factual information about the nuclear power program, including the full amount of those cost elements which can be determined at this time and the magnitude of the problems which must be overcome before nuclear power can compete with conventional fuels, the public will then decide if there is need for—

> extensive programs for the construction of publicly subsidized or publicly owned nuclear powerplants.

As set forth in the report:

> Some highly publicized statements, however, do not take these facts into serious consideration. Announcements of plans are sometimes mistaken for accomplishment of objectives. This would be of no serious consequence in itself, if it did not tend to affect future conditions. Words sometimes outrun deeds. Some real facts, such as the use of the threat of development of low-cost atomic power as leverage over conventional fuel and transportation costs, may well be magnified out of proportion in the public mind. This overmagnification in the public mind might add up to real losses of potential atomic benefits and reduce the value of peaceful atomic development as an element of United States leadership.

There are other ways in which this "overmagnification" reacts to the detriment of the public interest. The Nation's dependence upon conventional fuels for the bulk of its energy requirements means that the coal industry must have available to it ever-increasing numbers of trained engineers. Individual companies and associations within the industry have through the years established scholarships for the education of mining engineers. More are in contemplation. We expect to be able to meet our need for trained technicians. However, if our young people are erroneously led to believe that nuclear power will soon supplant conventional fuels, difficulties may be encountered in attracting sufficient numbers to this important field.

If this "overmagnification in the public mind" continues to grow, the Nation may well suffer from curtailed research on improved efficiency in the generation of electricity from conventional fuels. The

Bureau of Mines points out that electrical generating plants at present consume about 1 pound of coal per kilowatt-hour, and this is expected to be reduced, through continued progress, by at least 0.05 pound per kilowatt-hour for each 5-year period. The Bureau also states that—

> Direct conversion of coal into electricity is a possible interesting development but one that will not come into fruition until beyond the period under discussion.

"Overmagnification" of the prospects of nuclear power might cause some curtailment in efforts along these lines.

There is a way to correct the public's erroneous impression that low-cost nuclear power is on the verge of achievement. It can be done by the dissemination of facts. We believe the information contained in the panel report should help a great deal to bring about a better informed public opinion. The panel suggests—

> the technical and economic realities of this stage of development of peaceful uses, especially in the field of atomic power, are not as yet entirely favorable, that present profitability is doubtful, and that future profitability is still not certain.

The panel points out that—

> An atomic-power reactor is a complex, expensive, and potentially hazardous machine. It is not a small black box in which one only has to put a lump of fissionable material. It cannot be transported in the luggage compartment of an automobile. It requires for its fabrication highly specialized techniques and materials. Its design demands a knowledge and ingenuity possessed today by relatively few people in the world. The task of bringing this source of power into reality is as great as is the challenge it offers to our society.

As set forth in the report—

> Unless and until research and development demonstrate that atomic power can be economically feasible, there can be no substantial impact.

The panel says that not until 1960 will we—

> have adequate technological information at hand on which to base judgment of the economic possibilities of atomic energy as a power resource.

The report recognizes that—

> If the nuclear energy industry is to become economically self-sufficient, more economical treatment methods of wastes must be devised—

and that the insurance problem will have to be solved before privately owned reactors can be put into operation.

At a recent press seminar on nuclear power, Mr. Kenneth Davis, head of the AEC reactor development program, said:

> In fact, we don't today know really how to do the chemical processing for as little cost—just for this part of the nuclear fuel cost alone—as we can probably afford to pay. So there are still many unsolved problems here since the fabrication and the chemical processing are both rather large.

We believe, as the panel does, that proper dissemination of factual information of this type will contribute to a better informed public opinion with respect to nuclear power. Spectacular statements based on unwarranted optimism about the future availability of low-cost nuclear power have been all too common in the past. There is need to counteract the erroneous impression which has been communicated to the general public with facts—facts of the type contained in volume II of the report:

The fissionable material consumed by the nuclear plant represents but a small part of the nuclear fuel cost. When fabrication, reprocessing, and handling are included, nuclear fuel cost increases many times. The fuel cost computed in this manner for the *Nautilus* is about 50 times the cost of fuel oil for equal shaft power generation.

Instead of unfounded overoptimism, persons in a position to influence public opinion should disseminate information about the reasonable probabilities together with the known facts. It was recently revealed that power from the Shippingport reactor, which is the first full-scale power reactor which will be put into operation, is expected to cost in the neighborhood of 52 mills per kilowatt-hour in the early years of operation. This figure compares with a 3-to-8 mill range for power from conventional fuels. With proper publicity of the known facts, we will have a better informed public opinion.

In conclusion, I want to emphasize the following facts: The coal industry does not ask curtailment of basic and applied research in the field of atomic energy. We do seek a better informed public opinion through the dissemination of the known facts which bear upon the possibilty of achieving low-cost nuclear power. On the basis of the known facts, we believe that in most sections of the United States the most economic source of steam-generated electric power in the foreseeable future will be plants fueled by fossil fuels. We believe that for the foreseeable future the maintenance of a dynamic and expanding economy will depend upon the availability of ever-increasing amounts of low-cost energy from coal. We have the coal reserves necessary to meet the Nation's needs. We have the know-how and the manpower to produce that coal. We confidently expect to meet the Nation's expanding energy demands within the framework of the free enterprise system, without subsidy, and we believe the Nation's dependent upon coal warrants close congressional scrutiny to the end that legislative inequities against the coal industry shall be eliminated. We do not fear inroads upon our market by nuclear power—we believe that for many years to come the atomic energy program will consume far more coal than is displaced by nuclear power.

Thank you for the opportunity to appear here today on behalf of the bituminous coal industry.

Thank you, Mr. Chairman.

Chairman ANDERSON. Thank you, Mr. Pickett. I am glad to see that industry is willing to discuss and consider the possibilities of atomic energy upon its own future. I think that is a very hopeful and encouraging sign. I hope others may follow you in that path.

Representative COLE. May I just inquire if there presently exists any legislation inequities against the coal industry.

Mr. PICKETT. Yes, sir.

Representative COLE. Are there inequities that exist in the atomic energy law? I mean are there inequities which this committee might undertake to remedy?

Mr. PICKETT. I cannot think of any that might be properly directed to this committee.

Representative COLE. That is all.

Representative PRICE. I want to compliment our good friend Mr. Pickett, for a very fine and enlightening and constructive and impor-

tant presentation. I think you faced this very practically and in a fair and considerate manner.

I certainly agree with your final summation that we do not fear the inroads or impact of this industry because we all believe that for many years to come this program itself will consume more coal than it displaces.

I also want to comment on your earlier part of your statement where you indicate an avenue where you can work into the atomic energy program in your own way for the betterment of your own industry and for the development of new markets within your industry.

There are avenues where there can be a degree of cooperation for the benefit of the coal industry. I particularly refer to the conversion of solid fuel to gas. I understand that the Commission is conducting some experiments in that line with the use of atomic energy for this purpose.

Mr. PICKETT. Yes, sir.

Representative PRICE. I am wondering if your association is cooperating in any manner in that program or whether you have been asked to come into such a program?

Mr. PICKETT. We have not been asked to cooperate in any activity in that field. I assume that primarily it is because that is purely a technical matter which our association, as such, with the staff of employees that we have, is not technically capable of contributing anything to the knowledge required.

Representative PRICE. It would seem to me it would be one place where there could be a great degree of cooperation between the atomic energy program and the coal industry.

I know for years I have been interested in this very problem you mentioned in your statement. Those of us who live in coal producing States are forever looking for development of new markets for the coal industry. We are aware of some of the conditions that have existed in the industry. While sometimes they have been bad, I forsee a long period when the coal industry will be in an expanding stage rather than in the less expanding era that has passed.

Mr. PICKETT. We certainly hope that is true. We believe that it will be true if given the opportunity to eliminate some of the matters I referred to a moment ago, these impediments in the legislative field and certain other things. I do not think it would be appropriate to take this committee's time to discuss them here.

I would like to let you gentlemen know that our association, as companies or as an association, through the staff, would be more than happy to cooperate with the Atomic Energy Commission, any segment of it, or any other phase of the Federal Government's activities in which we have a mutual interest to the point that we arrive at a better understanding of each other's problems, how to arrive at the requisite answer to those problems and to the ultimate end that we can work together to improve the energy supplies and resources and their availability to this country.

Chairman ANDERSON. The next meeting will be tomorrow afternoon at 2 o'clock. That will be held in the old Supreme Court room.

(Whereupon, at 1:10 p. m., Wednesday, January 15, 1956, the hearing was recessed until 2 p. m., Thursday, February 16, 1956.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

THURSDAY, FEBRUARY 16, 1956

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 2 p. m., pursuant to call, in the Old Supreme Court Chamber of the Capitol, Senator Clinton P. Anderson (chairman of the Joint Committee) presiding.

Present: Senator Anderson (presiding), and Representatives Price, Cole, Kilday, and Van Zandt.

Chairman ANDERSON. The Joint Committee will come to order.

We are very happy to welcome today Mr. Willis Gale, of the nuclear power group of Chicago. Mr. Gale, I believe, is chairman of Commonwealth Edison.

We are glad to welcome you and to have your comments on this statutory hearing. We do not expect everybody to come but we certainly want to have those organizations and individuals who are planning large things in this reactor field. We feel it is very, very important, and we are very happy to have your comments.

Representative COLE. I would appreciate it if you would permit me to remind you and the other members of the committee that Mr. Gale was one of the early pioneers that we had to plow the field to make it possible to sow the seeds which developed into the modification of the Atomic Energy law. I am glad to see him back here again as a witness, and I will be glad to hear his statement.

Chairman ANDERSON. I think it is well to have that statement from an individual who worked so hard on the new law, and I am glad to have it in the record.

Will you proceed, Mr. Gale?

STATEMENT OF WILLIS GALE, CHAIRMAN OF COMMONWEALTH EDISON CO., CHICAGO, ILL.

Mr. GALE. At the outset, I want to thank you for your invitation to me to appear here today to discuss the interest of Commonwealth Edison Co., and its associates in atomic power.

The beginning of nuclear power for us dates back to May, 1951, when we entered into an agreement with the Atomic Energy Commission to study the practicability of applying atomic energy to the production of power.

Our study group was later enlarged and our research expanded. Our group has invested several hundred thousand dollars and some of its best engineering talent in this atomic power research. We have

done this because we believe that a significant atomic power industry will be developed. We also believe that such a development is in the national interest.

These studies led to our proposal to the Atomic Energy Commission last March for the construction of a full-scale nuclear power plant about 47 miles southwest of Chicago.

This plant is the largest all-nuclear power plant yet scheduled. Its capacity will be 180,000 kilowatts. It will be a boiling water reactor, a type developed by the Argonne National Laboratory.

The plant, when completed in 1960, will not produce electricity as cheaply as today's modern coal-fired plants. We believe, however, that eventually competitive nuclear plants will be built. We also believe that the only way to achieve this goal is through the experience and know-how gained from building and operating a full-scale facility.

Building a noncompetitive nuclear plant presents a problem for a regulated electric utility like Commonwealth Edison. Our present customers cannot be expected to bear a large burden for the benefit of future customers. Our stockholders cannot be expected to bear the brunt of large development costs because, if a cheaper way is found to produce electricity, the benefit will flow to our customers and not to our stockholders.

We believe that we have worked out a financing plan which is fair to both our customers and our stockholders.

General Electric Co. has agreed to build our plant for $45 million. Comonwealth Edison will own and operate it and will pay $30 million toward the $45 million contract price. This $30 million, plus the cost of the site and overhead costs, will be included in our utility plant account. On this basis (which leaves out $15 million of the total cost), we estimate that the nuclear plant will produce electricity at an overall cost of three-fourths of a cent per kilowatt-hour—a cost approximately competitive with new coal-fired plants in our service area. The $15 million remainder of the contract cost will be paid as a research and development expense over a period of 5 years by our research group. Were we to capitalize the $15 million research item, our estimated overall power cost would be one-third higher, or about one cent per kilowatt-hour.

In other words, by not including the research expense, the charges to our cost of doing business for the electricity supplied from the nuclear plant will be about the same as the cost of the electricity supplied from our coal-fired plants.

The $15 million will be truely a research and development expense—a cost incurred to learn how to build and operate a competitive nuclear plant.

It has been long established that a utility can properly charge to its current operating expenses a reasonable amount for research and development. Although today's customers gain nothing from today's research expenditures, they benefit from the research expenditures of the past. However, we felt that $15 million of research and development cost in connection with this "demonstration" plant was too large an expense for Edison alone. When shared with the seven other companies in our group and spread over a 5-year period, the extra cost is a reasonable research and development expense for each of us.

The $15 million is being paid through Nuclear Power Group, Inc., a nonprofit corporation which also is conducting continuing nuclear research. NPG is making studies of other promising types of power reactors as well as following the design and construction of the Commonwealth Edison reactor.

The companies associated in NPG and their contributions to the research cost of our plant are as follows:

Commonwealth Edison	$2,833,334
American Gas & Electric Service Corp	2,833,333
Pacific Gas & Electric Co	2,833,333
Union Electric Company of Missouri	2,000,000
Illinois Power Co	1,500,000
Kansas City Power & Light Co	1,500,000
Bechtel Corp	1,000,000
Central Illinois Light Co	500,000
Total	15,000,000

Mr. Philip Sporn, president of American Gas & Electric, is now president of NPG and, I understand, is planning to appear at these hearings.

As you know, our project is proposed to be built without any governmental subsidy. The reason that we are able to do this is the $15 million of research contributions. Also, General Electric Co. has been especially helpful because its contract price of $45 million is, we believe, very favorable.

We have been working closely with the Atomic Energy Commission and we were glad indeed to note from the newspaper reports of these hearings that a construction permit for our plant will be granted soon. In all fairness we must say that the staff of the Commission has been most cooperative and helpful both to us and to General Electric in connection with our project.

The granting of a permit, however, will still leave one major obstacle in the path toward construction of the plant. I am referring to the problem of insurance.

Our proposal to the Commission and our contract with General Electric Co. are conditioned upon the satisfactory solution of the insurance problem, at a reasonable annual cost, before the end of 1957.

Beginning in January of this year, we and our associates are paying General Electric Co., monthly, one-sixtieth of $45 million. By the end of 1957, when we must know the answer to the insurance problem, we will have paid General Electric a total of $18 million. We would lose only a part of this $18 million if we canceled the project at the end of the 2-year period but we and General Electric are spending money at a rapid rate.

We, therefore, feel that we are entitled to an answer to this problem in the very near future.

At this point I would like to explain what I mean by the insurance problem.

I am not talking about insurance to cover our own property. I have no doubt as to the availability of property insurance at reasonable costs. But even if we could not get a dollar of property insurance for our $45 million plant, we would not be too concerned. We would know that our potential loss in this respect would be limited to the facility involved.

I am not talking about third-party liability insurance in the ordinary sense. The $50 million to $60 million of third-party liability coverage which the insurance industry is proposing to make available is, I believe, more coverage than is in force to protect any existing industry in this country.

For ordinary contingencies this insurance should be more than adequate.

We do not know, of course, what this third-party liability insurance will cost. It will present a problem only if the cost is so high as to destroy the economics which were the basis of our decision to proceed with our project.

What we are really concerned about is the extraordinary third-party liability from a major nuclear catastrophe.

At this point I would like to make it clear that we believe that nuclear reactors will demonstrate, in due course, an outstanding safety record. Our designers will provide every possible safeguard against a nuclear incident. The Atomic Energy Commission will check these safeguards with the greatest care. We are confident that our facility will be as near to perfection as any device made and operated by humans.

Nevertheless, a period of years of actual experience will be needed to prove what we now believe to be true. There is no substitute for this actual period of experience.

The likelihood of a major nuclear incident is extremely remote, but, if it should occur, the potential damage might be extreme.

We have explored this matter with a number of the best qualified experts. We have hoped that we could be assured that the risk is too remote to be considered. But we have not found a single expert who is willing to say that, without a period of years of actual experience, the hazard, although extremely remote, can be ignored.

I mentioned that we would be willing to make a $45 million investment even though property insurance were not available. I repeat this to emphasize that we are willing to take a sizable risk.

However, our stockholders have an equity in our company of more than $700 million at market value. Also, we have a tremendous responsibility to finance a rapidly increasing demand for electric service by 1,800,000 customers in the Chicago area.

At this time we do not see any sound basis on which we can risk our solvency on the possibility, remote as it may be, of a major nuclear catastrophe.

I do not desire to appear too positive about this. I cannot say at this time what our directors will decide 2 years hence. I will say, however, that 2 years from now we will know very little more about the risk than we know today. Only after a considerable period of years of actual large-scale power reactor operation, will businessmen be able to evaluate the major catastrophe risk.

In my opinion, this is not really a matter of insurance in the usual sense. It is a matter of the assumption of a very remote but tremendous potential risk.

If this catastrophe risk is not a matter of insurance and if it is beyond the ability of an owning company to carry, how can it be handled?

One possibility, which we do not favor ,would be in some way to limit the liability of the owner of the reactor. This, it seems to us, would concentrate the risk in the wrong place.

The other possibility would be for the catastrophe risk to be assumed by the Federal Government. If reactors are to be built, this risk must be assumed by someone. The development of competitive nuclear power is in the interest of all the people. Why not have the risk shared by all the people through the Federal Government?

If, through failure to meet this problem, the Government builds all the demonstration reactors, it will be required to pay the full cost of the reactors and carry the entire third-party risk as well.

We do not think of this assumption of the catastrophe risk as placing the Federal Government in the insurance business. It already has some responsibility through ownership of nuclear fuel. Why shouldn't the Government take the full responsibility for the catastrophe hazard if the reactor owner has provided a reasonable amount of ordinary private third-party insurance coverage?

You might ask whether we would be willing to pay for this assumption by the Government of the catastrophe risk? Again the answer is, "Yes," if the economics of our project would not thereby be destroyed. I say this despite the fact that I sincerely believe that the Federal Government would never be called upon to pay a single claim. A further consideration is that the entire problem, in my opinion, should be solved as simply as possible.

Before I conclude, I should point out that everything I have said applies equally to the builder of a nuclear plant—in our case, General Electric Co. and its subcontractors.

Thank you.

Chairman ANDERSON. Thank you, Mr. Gale. I think that illustrates why we like to have these hearings. There was a disposition in the minds of many to think that the insurance problem might not be a problem. I think 6 months ago there was some assurances that private industry was going to work out some scheme for taking care of that, I mean the private insurance carriers. I am glad to have this statement of yours that it is still a very great problem, because it means we have something to study.

I would like to come to page 7 of your statement for just a second, the next to the last paragraph:

> We do not think that this assumption of the catastrophe risk is placing the Government in the insurance business. It already has some responsibility through ownership of nuclear fuel.

Now, when we were having a hearing yesterday I pointed out that the Government had some responsibility as the owner of that nuclear fuel. Suppose that we decided that your assertions on insurance were just not well founded and we were not going to pay any attention to them, and that thereby discouraged you, and I am taking a very bad case, you understand. But suppose it discourages you, and you said:

> We have spent some money and we are willing to forget that because we are not going to build this reactor until we know.

Would not there then be a very strong demand in this country for the Government to build a group of reactors such as the Gore bill contemplated?

Mr. GALE. I am sure there would be.

Chairman ANDERSON. Would not the Government have the responsibility in that case?

Mr. GALE. Yes, sir.

Chairman ANDERSON. So the Government is likely to have that responsibility no matter how it proceeds, unless we are able to work out something that is satisfactory to you. In other words, if you have to abandon the field and the Government has to step into it, the Government would assume the same responsibility that it might assume in case you people went ahead in the field. So, it cannot avoid that to some degree?

Mr. GALE. That is exactly right.

Chairman ANDERSON. Also on that page, you have a paragraph that I wondered about. You say:

> One possibility which we do not favor would be in some way to limit the liability of the owner of the reactor. This, it seems to us would concentrate the risk in the wrong place.

I do not like the word "concentrate." Would it not just scatter the risk all over the country, so that every person that might be exposed to radioactive damage would be himself an insurer of his own life and his own property?

Mr. GALE. That is correct.

Chairman ANDERSON. It does present a pretty severe problem if we would limit the responsibility of the reactor owner. It would be a problem to those people who might be exposed to radiation in case there was a disaster of the reactor. However, in order to reassure the public a liability, you do not expect the reactor to ever blow up, do you?

Mr. GALE. No, sir, I am sure that reactors will be as safe as any facility that mortals have ever built.

Chairman ANDERSON. I repeated yesterday that Dr. Lawrence and Dr. Bradbury and people of that nature, and also Dr. Zinn, who have had a great deal of experience, were absolutely sure in their own mind that a reactor would never blow up.

Mr. GALE. That is correct.

Chairman ANDERSON. You are only trying to say that common prudence would dictate that it might, and on the basis of that slim possibility there ought to be some decision as to what happens on the liability if that takes place?

Mr. GALE. That is right.

Chairman ANDERSON. It is not the attempt to indemnity you for the destruction of our own property?

Mr. GALE. No, sir.

Chairman ANDERSON. And you are not worried about property damage in the immediate vicinity, that is, automobiles parked near it, but you are thinking about that greater hazard that might happen if something serious went wrong?

Mr. GALE. That is exactly right, sir.

Chairman ANDERSON. Thank you.

Representative PRICE. Mr. Gale, I think that you have pointed out the subject that all of us on this committee are deeply interested in. I think probably it is our plan, Mr. Chairman, to hold a separate hearing at some time or give separate consideration to the matter of insurance.

Chairman ANDERSON. My thought was that anything that came up in these hearings, that indicated additional studies, we would go ahead with. We had an understanding among ourselves last year with Congressman Cole that we would give some further attention to the patent situation. I certainly want to make good on that commitment and it seem to me, that we now are going to have to give some special attention to the insurance situation.

Representative PRICE. We are deeply interested in that problem, Mr. Gale, and I think that this committee will give the most serious consideration to it, and try to eventually arrive at the answer that not only your group is interested in but which all industry participating in this program is concerned about. I have found your statement very interesting, and I would subscribe fully to everything that you have said in it.

Mr. GALE. Thank you, sir.

Representative COLE. First I would like to inquire if Mr. Gale, in his concluding paragraph, intends to indicate that the General Electric Co. subscribes to all of the thoughts which Mr. Gale has expressed in his statement?

Mr. GALE. I know General Electric Co. has fundamentally the same approach that I do. I am not authorized to speak for them.

Representative COLE. I want to be sure about that.

Mr. GALE. I am sure there is no difference whatsoever. I know that they have been as much concerned about this problem as Commonwealth Edison has been, and I believe that Mr. McCune plans in due course to testify, and I am sure that he will confirm what I am saying.

Representative COLE. Well, I hope that he does not, because of the same paragraph in your statement to which the chairman has alluded. That statement is where you refer to the insurance, especially where you say that to impose the liability upon the owner or operator of the reactor would be to place the risk in the wrong place. With that I disagree just 180 percent. I think that the risk rests with the owner and operator of the reactor. It is not with the Federal Government. It is not the special nuclear material that causes the damage, it is the use in the operation, or the working of that material by the operator, through carelessness, through defective mechanism, or through something that happens that causes that special nuclear material to get out of bounds and cause the damage. I do not see any reason at all why the taxpayers up in my little town in New York State or any other part of the country should bear the liability for damages caused by the ineptness, or inexperience, or whatever cause may be assigned to the catastrophe that may occur.

CHAIRMAN ANDERSON. Could I break in there. It seems to me that he is misreading what you had in mind. You said, "Limiting the liability of the operator," and thereby we might pass a law that said that the operator of the reactors would have a liability of $10 million or $20 million and no more.

Representative COLE. He says that they do not favor that, and that is just what I think is the solution—for the Federal Government and for the Congress to limit the liability of the operators of the reactors.

Mr. GALE. I did not understand your position on that.

Representative COLE. Perhaps measured by the amount of capital investment in the reactor, or twice the capital investment, or three

times, or whatever appears to be fair. Of course, there has got to be something, and the operator must know in advance the greatest liability that he might be exposed to. Otherwise, he is not going to run the risk of investing his money in it, and there must be something ahead of time. If he cannot be reassured by buying the protection from insurance companies, he has to have that assurance from some statute that will protect him. Now, there is a question in my mind of course of the constitutionality of such a law, and yet it is pretty well resolved with respect to bank stock liability. The Congress did fashion a different liability in that respect. I know in bankruptcy the Congress is given authority to regulate bankruptcy proceedings in which creditors of an insolvent corporation are required to share the assets. That same philosophy, it seems to me, can be applied to find a solution to this problem. So, I not only disagree with your contention when you say that limiting the liability is not the right answer, but I also disagree with your conclusion when you say to impose the liability on the operator is putting the risk in the wrong place, because I think that that is where it should be.

That is what prompted my original inquiry to learn whether General Electric subscribed to that thought which you have expressed with respect to insurance.

Now, let us discuss it for a moment.

Mr. GALE. I cannot state it much better than I have tried to state it here, sir. I understand that you agree that Commonwealth Edison should not risk its solvency as well as around $40 million on the development of this facility.

Now, to my mind it is a question of whether the people in the vicinity of our facility should bear the risk or the people all over the country should bear it. That is specifically my point.

Representative COLE. Why do you think the people all over the country should bear it?

Mr. GALE. Why should the people in the immediate vicinity bear it?

Representative COLE. They are having the advantage of the energy that it produces.

Mr. GALE. I think that is true in the long range, but I look on this as a matter of development—getting the show on the road. It is in the interest of all the people of the country to carry out these plans. The likelihood, or the mathematical possibility, of the Government ever paying anything, would be infinitesimal.

Representative COLE. I feel that you must agree that it is conceivable that the damages might be so great that even the Federal Government could not indemnify it.

Mr. GALE. That might be.

Representative COLE. That is an extreme and fantastic and fanciful view.

Mr. GALE. That is correct. But my position is supportable during the period of development of this art. I would say that in the case of the reactors built after 10 years or some period like that, the people that built them ought to know what they were getting into. But I think that you cannot get away from the fact that one way or another there is an element of partnership in the development of this art. Here is a place where I think it is not improper for the Federal Government to have participation.

Representative COLE. It is a question of how the Federal Government will exercise its place.

Mr. GALE. Yes, sir.

Representative COLE. I assume that you would not have any serious disagreement with the idea of limiting the liability?

Mr. GALE. As far as Commonwealth Edison is concerned, no. We could not object to that point of view.

Representative COLE. Of limiting the liability?

Mr. GALE. Yes, sir.

Representative COLE. So that you know in advance just what that liability is?

Mr. GALE. Yes, sir.

Representative COLE. I have only one more question, and that is to clarify your expression. In referring to your project, you say that this is the "largest all-nuclear powerplant." I wondered what significance if any, was in the expression.

Mr. GALE. In the case of Consolidated Edison Company of New York the proposed facility is in total considerably larger than ours, but it has an oil superheater, or something like that, so it is not a pure atomic facility.

Representative COLE. Thank you.

Representative KILDAY. I have no questions.

Representative VAN ZANDT. I have no questions.

Chairman ANDERSON. To come back to this insurance for just a second, you mentioned General Electric, and said that General Electric was going to build this for about $45 million?

Mr. GALE. Yes, sir.

Chairman ANDERSON. Actually General Electric cannot really make a profit but may take a loss on the operation. If it assumed a responsibility as a result of an explosion which could wipe out the entire assets of General Electric, as it could, it would not be very much interested in taking an unprofitable contract in that sort of a risk.

Mr. GALE. I think that is a very fair statement.

Chairman ANDERSON. That adds some point to what we are discussing in Congressman Cole's point, of limiting liability. It is how we limit the liability so General Electric will feel free to go ahead and build a plant for $45 million, on which it could conceivably lose money, and how your company could put in $30 million plus some more, on which it conceivably might wait a long time before it got any money back. In exchange for that it would not want to take on an unlimited wide-open liability that would destroy the assets of all of its stockholders.

Mr. GALE. Not only that, but it would not be in the public interest, because we have a tremendous responsibility, and we are spending on an average of $150 million a year on new conventional facilities, to supply a very fast-growing demand for electric service, and our solvency is important to the people of Illinois.

Chairman ANDERSON. These things sometimes do take a long time to work out. I can remember and it was not so very long ago, that I would not let my company write insurance on a cotton gin, and now I wish that I had many of them covered. They change in their hazard, and they are special hazards 1 year and 10 years later they are not. I think this is a fine paper.

Representative COLE. In connection with the chairman's remarks that General Electric might do this job at a loss for your company, of course you cannot speak for General Electric but in your discussions and your negotiations with GE, arriving at $45 million, was it indicated that GE might lose on this deal?

Mr. GALE. I would rather you would discuss that with Mr. McCune. He knows firsthand about it.

Representative COLE. I am only asking you if in your negotiations with GE, they indicated they might lose on this job?

Mr. GALE. Well, I will say that I am sure they are not going to make anything.

Representative COLE. That is not what I am asking.

Mr. GALE. That is as far as I know, sir.

Representative COLE. How can you be sure that they are not going to make anything?

Mr. GALE. I cannot be sure, sir. I can only judge that.

Representative COLE. Do you have in your agreement with GE some rigged sort of a contract like we have in Congress, a renegotiation of price?

Mr. GALE. No, sir.

Representative COLE. It is a firm price?

Mr. GALE. Yes, sir.

Representative COLE. Well, I am rather surprised that GE, having had all of this experience in the reactor technology and having taken advantage of being on the inside of this deal all the way through, and being in a preferred position that we have been hearing about for the last couple of years, now when it comes to a question of commercializing on its inside information it is going to do so at a loss. It would be interesting, I think and I hope Mr. McCune, if he is here, or if he is going to be here, will discuss that. It is conceivable of course that GE will continue to lose on these types of jobs. If so, it belies the charge that has been levied against those big companies that have been in on the deal that they are going to profit and reap big profits out of that inside position. I would be interested to have that.

Mr. GALE. In my own view of it, and I am very reluctant to speak for General Electric, and I hope you appreciate that, sir, but from Commonwealth Edison's point of view we are not in this to make money.

We think that it is of tremendous importance to our industry and to the country as a whole to get this show on the road and we are willing to take some chances. I think that is the same basis on which General Electric is approaching this.

Representative COLE. There was another question, Mr. Chairman, which was developed at the meeting yesterday. What part of the cost of this project will your State utilities regulatory body permit you to charge in your rate structure?

Mr. GALE. We will not face that question until the plant is in operation. That is because that is the way regulation operates. However, under the mechanics we have devised, whereby the amount that we charge to our ordinary power costs will be, we believe, approximately equivalent to the cost of electricity from coal, we think that there is no question about the propriety of charging the $30 million cost to our investment for ratemaking purposes. We have no assurances about that in advance.

Now, so far as the research part, our $2,800,000, and the other Illinois utilities, Illinois Power and Central Illinois Light, they are similarly affected as Commonwealth Edison, where we are paying out certain amounts a year. We have been authorized by the Illinois Commerce Commission to make the payments.

I do not remember precisely the form of the Illinois Commerce Commission order, but I am sure, however, that it does not state that those payments will be chargeable for ratemaking purposes. However, I believe they should be.

Representative COLE. You anticipate that they will be?

Mr. GALE. I anticipate they will be because of the mechanics we have very carefully worked out make the way we are doing this, with the help of these other companies, such that there cannot be any criticism from a ratemaking point of view.

Representative COLE. Thank you.

Chairman ANDERSON. I raised a general question, and I was merely trying to say that on a $45 million job where plans had to be indefinite, they had no real way of knowing where they were going to make or lose money. It is pretty hazardous.

Thank you very much, Mr. Gale.

Mr. GALE. Thank you, sir.

Chairman ANDERSON. Our next witness this afternoon is Mr. Walker L. Cisler, and Mr. Cisler we have known of your long interest in these projects and your determination to see these plants built. It is a pleasure to welcome you here this afternoon and to welcome you to this committee.

STATEMENT OF WALKER L. CISLER, PRESIDENT OF POWER REACTOR DEVELOPMENT CO., AND ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

Mr. CISLER. Mr. Chairman and gentlemen of the committee, I appreciate very much the opportunity to appear before you today. My name is Walker L. Cisler, and I am president of the Power Reactor Development Co., a nonprofit corporation organized on August 30, 1955, under the laws of the State of Michigan. I am also president of the Atomic Power Development Associates, Inc., a nonprofit membership corporation organized on March 10, 1955, under the laws of the State of New York, as successor of an earlier unincorporated group known as Atomic Power Development Associates. I make this statement on behalf of both companies.

On March 30, 1955, the Detroit Edison Co. in behalf of itself and the Central Hudson Gas & Electric Corp., the Cincinnati Gas & Electric Co., Consumers Power Co., Delaware Power & Light Co., Long Island Lighting Co., Philadelphia Electric Co., Rochester Gas & Electric Corp., the Toledo Edison Co. and others, who later incorporated Power Reactor Development Co., offered to participate in the power demonstration reactor program announced by the United States Atomic Energy Commission on January 10, 1955, by proposing to design, construct, own, and operate an experimental fast neutron breeder reactor. The Atomic Energy Commission on August 8, 1955, accepted the proposal as the basis for negotiation.

With that proposal there was submitted a design of a reactor which reflected not only the work of the engineers and scientists of Atomic

Power Development Associates, Inc., but also information available from various other sources, including the laboratories of the Atomic Energy Commission, especially the Argonne National Laboratory.

The proposal was to develop and improve a breeder reactor which will lead to the production of steam for the generation of electric energy and other products from nuclear fuels on a commercially competitive bases, subject to the granting by the Atomic Energy Commission of—

(*a*) a license to locate, construct, own, and operate a reactor to demonstrate its practical value, and

(*b*) a license to possess special nuclear material, and

also subject to reaching an agreement which would insure—

(1) a sufficient supply of fuel and blanket materials;

(2) the processing of irradiated fuel and blanket elements;

(3) a fixed and adequate price to be paid by the Atomic Energy Commission for special nuclear material produced by the proposed breeder reactor; and

(4) the performance of certain research and development work in Commission facilities.

The then estimated total cost of the proposed reactor was $45 million.

The proposal contained the following conditions:

1. That neither the licensee corporation nor any member thereof or contributor thereto will become subject to the Public Utility Holding Company Act by reason of participation in this project.
2. That the contributions of the members to the licensee corporation will qualify as deductible for Federal income tax purposes.

The proposal emphasized the necessity that the licensee be reasonably sure of its ability to obtain adequate public liability insurance.

That corporation, Atomic Power Development Associates, Inc., was organized March 10, 1955, for—

(1) scientific and educational purposes;

(2) to discover and study economic ways to produce and use nuclear material and atomic energy for the generation of usable energy; and

(3) for industrial and commercial applications that may appear to be of practical value.

Its certificate of incorporation expressly provides, among other things, that no part of any net income of the corporation shall inure to the benefit of any member or private individual.

The present membership consists of public utility, manufacturing, engineering, and construction companies, totaling 43 in number, shown in exhibit A.

As of December 31, 1955, there has been expended the sum of $7,200,000 in furtherance of the objectives of Atomic Power Development Associates, Inc. The budget for 1956 calls for the expenditure of $5,180,000, which will be provided by its members.

This nonprofit corporate entity actively functions as a research and development group. It seeks to develop improved breeder reactors. The results will be available and disseminated to those who might qualify as eligible to receive this information, including the Power Reactor Development Co.

Representative COLE. May I interrupt at this point. To make sure that the record is clear, you say that this organization was organized

on March 10, 1955, and then you say as of December 31, 1955, you have spent $7,200,000. Do you mean that in the 9 months time that organization has spent that?

Mr. CISLER. No, Mr. Cole, the work undertaken since 1950, both by the predecessor, the Atomic Power Development Associates——

Representative COLE. I thought sure that was the fact, but it was not in your statement.

Mr. CISLER. It was not as clear as it should be. It is $7,200,000.

Representative COLE. That is the accumulated expenditure of the component members of this organization?

Mr. CISLER. Yes, over the entire period since 1950.

Chairman ANDERSON. You went back and picked up the individual amounts and consolidated them into this $7 million figure?

Mr. CISLER. Yes.

Power Reactor Development Co.: This nonprofit corporate entity was incorporated to design, construct, own, and operate a fast neutron breeder reactor to provide heat energy—steam—ultimately capable of operating a turbine-generator of 150,000-kilowatt capacity. Twenty-six companies, many of which are members of Atomic Power Development Associates, Inc., have signified their intention of becoming members of this company and to contribute upward of $25 million to it when the conditions of the proposal of March 30, 1955, are met. The membership of this company is shown in exhibit B.

Among its corporate purposes are the following:

> To study, develop, design, fabricate, construct, and operate one or more experimental nuclear power reactors and any or all component parts, to the end that they may be an early demonstration of the practical and economical use of nuclear energy for the generation of electric energy, together with such industrial and scientific products and by products and applications as may seem desirable, * * * to collect or otherwise acquire information relating to the purposes of the company and to communicate such information to the United States Atomic Energy Commission for the use of the public, and to disseminate such information to its members and to all others who may reasonably request such information for their proper business purposes, to the extent permitted by law. * * *

The articles of incorporation provide that upon its dissolution that:

> Any property remaining in its hands after the discharge of all its obligations shall be distributed to such corporation or corporations organized and operated exclusively for educational or scientific purposes, * * * to be used by such corporation or corporations solely for educational and scientific purposes to further research and development in the use of atomic energy for peaceful purposes. It is the intention of the incorporators that all funds and property of this company shall be devoted to the purposes hereof and shall not revert to those furnishing it with funds; accordingly, at no time shall any property of the company be returned to the original incorporators or other members or to any donors or contributors.

The relative objectives of the two companies: We have taken a two-fold approach. First, through the facilities and personnel of Atomic Power Development Associates, Inc., research and development is being fostered, and second, while such research and development is being carried on, Power Reactor Development Co. will design, construct, own and operate an experimental fast neutron breeder reactor to provide heat energy ultimately capable of operating a turbine-generator wiht a capacity of 150,000 kilowatts. Greater concentration upon the respective objectives of these two companies and the cooperative relationship between the two will bring about rapid progress.

We can reasonably hope that before the first experimental reactor has been completed and in operation, the research and development being carried on by Atomic Power Development Associates, Inc., will have progressed in the design of a second and improved reactor. Component parts of our first experimental reactor have been designed by it and some parts are being fabricated and will be subjected to test operations soon. Other component parts will be designed, constructed and tested during the present and following years.

One of the experiments now underway is concerned with the interaction of water and sodium-potassium which is used as a heat transfer medium in the fast breeder liquid-metal-cooled type of reactor. These tests started in June 1955 and will continue through August of 1956.

It is expected that about April 1, 1956 tests will commence to determine heat transfer and other characteristics of a once-through type boiler. This will represent a unique design not heretofore used or contemplated under conditions of the heat transfer between a liquid metal and water or steam. The major components for this purpose have been delivered. These tests will cost more than $270,000.

A most important test to be made is that which will cover a full size reactor vessel, a rotating shield and top closure, fuel elements, remote charging and discharging mechanisms, control rod system—including actuators—and a complete full-size loop for handling sodium coolant.

These parts are now in manufacture, and deliveries are expected, and installation at a test location will be made, so that testing can begin before the end of 1956. These test facilities and test will cost about $4 million.

These tests will be time consuming, and are regarded as essential. It is expected that these tests will provide background information not heretofore known, and will result in improved design which will be incorporated in the first reactor—and most certainly in any subsequent reactor.

When these preliminary tests have been carried out by Atomic Power Development Associates, Inc., it is hoped that many of the components can then be moved directly to the reactor site and installed by Power Reactor Development Co. for further testing.

The progress of Power Reactor Development Co. has been retarded by the status of the company and its prospective members under both the Public Utility Holding Company Act and the income-tax laws.

Nevertheless, the project has been moving forward, while awaiting the fulfillment of the conditions expressed in the proposal of March 30, 1955.

A permanent staff and headquarters have been set up by this company. Many scientists, engineers and management personnel connected with those interested in Power Reactor Development Co., are engaged in the actual carrying out of the project, particularly in the design and construction planning of the developmental reactor plant.

Work is proceeding upon the site for the reactor on the westerly shores of Lake Erie, approximately 6 miles north of the city of Monroe, Mich.

The construction schedule of the Power Reactor Development Co. calls for the expenditure of $2 million during the year 1956. If the conditions expressed in the proposal made to the Atomic Energy Commission on March 30, 1955, are promptly satisfied, I believe that construction will move forward with dispatch.

The Detroit-Edison Co.—of which I am president—is prepared to build a turbine-generator plant to produce electric energy with the steam produced by the reactor, if the conditions expressed in the proposal of March 30, 1955, have been met. This plant will be located on the same site and immediately contiguous to the reactor plant itself.

Power Reactor Development Co. is in the midst of negotiations with the staff of the Atomic Energy Commission, and several drafts of a proposed agreement with that Commission have been examined and discussed.

I expect that a final agreement will be reduced to writing for Commission approval within a short time.

On January 6, 1956, Power Reactor Development Co. applied to the Atomic Energy Commission for a construction permit. It is hoped that the issuance of such permit will follow soon.

Representative COLE. May I interrupt to inquire, Mr. Cisler, if you expect that agreement with the Atomic Energy Commission will resolve the conditions which you attach to your proposal, number one being that you be exempt from the Utility Holding Co. Act and that your contributions be exempt from taxes, and so forth?

Mr. CISLER. I would believe, Mr. Cole, that those aspects will certainly not all be taken care of by the time we reach an agreement on a contract.

Those would have to be provisions that were stated in the contract for which the Commission would not have a responsibility.

Shall I proceed, sir?

Chairman ANDERSON. Proceed.

Mr. CISLER. Public Utility Holding Company Act.

There is presently pending before this Congress proposed legislation, S. 2643, to make certain that neither a licensee corporation, such as Power Reactor Development Co., nor any member thereof or contributor thereto, will become subject to the Public Utility Holding Company Act by reason of participation in the design, construction, or operation of an experimental reactor. This legislation is indispensable. Hearings before the appropriate committees of Congress are expected to be held shortly.

The proposed legislation will not remove from the jurisdiction of the Securities and Exchange Commission acting under the provisions of the Public Utility Holding Company Act, any company or companies now subject to the provisions of that act.

I am advised by our counsel—and I accept their advice—that Congress in the enactment of the act did not intend to subject the companies engaged in this project to its provisions.

I further have been advised by our counsel, and other participants have been similarly advised by their respective counsel, that the language of the existing act might be so construed. This interpretation would prevent the broad and extensive participation of the many companies in this project.

I am also advised that, although Congress did not intend to subject to the jurisdiction of the Securities and Exchange Commission nonutility and industrial companies participating in this project, nevertheless, the language of the act in its present form is susceptible of that construction.

Utility companies, not now subject to the provisions of that act, and industrial companies who have joined with us to promote the

early development and use of the atom for domestic and peacetime purposes, are unwilling to become subject to the provisions of another act. The proposed legislation does not conflict with the purposes of the Public Utility Holding Company Act.

Chairman ANDERSON. I have asked the staff to find out where that bill is and we will see if there is anything we can do to help you out on that.

Mr. CISLER. Thank you, sir.

Now, as to income tax exemption, in April of 1955 the Atomic Power Development Associates, Inc., made application to the Internal Revenue Service to establish the character of the contributions by members to that company as deductible in determining their taxable net income. Discussions have been held with representatives of the Service, but as of the date of the preparation of this statement, no ruling has been received.

The Power Reactor Development Co. has recently made a similar application.

In the absence of the passage of the suggested legislation and a favorable ruling by the Internal Revenue Service, it would be very difficult to finance this project to completion.

Insurance: We have joined with the Atomic Industrial Forum and others in financing a study being made by Columbia University of insurance hazards, at an estimated cost of $50,000. This study, when completed, should be of value to the Atomic Energy Commission, the insurance companies authorized to do business within the United States, and those engaged in establishing the peacetime uses of atomic energy.

The absolute necessity of insurance against a catastrophe involving extensive public liability, in adequate amount, cannot be overstressed.

And I do share with Mr. Gale and his associates his very great and deep concern regarding the matter of insurance.

As soon as these problems of the applicability of the Public Utility Holding Company Act, income-tax liability, and public liability insurance are resolved, I am confident that swift fulfillment of our purposes will follow.

Chairman ANDERSON. Will you stop there, Mr. Cisler, and allow me to ask you if you think any useful purpose would be gained by having a seminar on insurance here with the joint committee sometime?

Mr. CISLER. I think it would be extremely helpful, sir.

Chairman ANDERSON. Do you think 3 weeks would be time enough for your folks to be ready?

Mr. CISLER. Yes.

Chairman ANDERSON. I was going to ask Mr. Gale the same question, but he has left. We will ask him in any event.

I have a communication from the Yankee Atomic Development Co. in which they mention the insurance question. Thus far we have not been able to get into this.

I suggested at one time that a member of our staff discuss this with the people who were in it and they did not feel it desirable at that time to do it.

But I believe if we are going to be helpful to you, we have all got to look at the same set of facts.

Mr. CISLER. It is very important that this be brought into focus so that we can all understand.

Chairman ANDERSON. We will try to find a date mutually agreeable to bring this before the full committee.

Mr. CISLER. Thank you.

Order of Michigan Public Service Commission: On March 23, 1955, the Michigan Public Service Commission upon the application of the Detroit Edison Co., and after a full and complete hearing, including witnesses called by the Commission, found, among other things, that it was proper for the Detroit Edison Co., and, as a matter of fact, its duty, to engage in research and development work intended to establish the economic practicability of the fast neutron breeder reactor.

It is expected that the Consumers Power Co., which is also subject to the jurisdiction of the Michigan Public Service Commission, will file a similar application with that commission.

I anticipate that the Detroit Edison Co., within a relatively short time will file a petition to amend the order of March 23, 1955, so that it may, among other things, be authorized to increase its contribution to a maximum of $6,250,000 over a 5-year period. A copy of the order appears as exhibit C.

Representative COLE. Mr. Cisler, may I inquire what understanding does Detroit have, or what is your understanding with respect to the eligibility to charge, in your ratemaking applications, to the State authority, the expense in connection with the development of atomic energy?

Mr. CISLER. Mr. Cole, this expense would be charged as an operating expense and not charged into the capital account.

Representative COLE. What does that mean, that in order to be considered in fixing the rates it would have to be charged to capital expenditures?

Mr. CISLER. No, it would not be charged as a capital expenditure, but would be charged as an operating expense at the rate of a million and a quarter dollars a year charged to the research account.

Representative COLE. I still do not understand. Will the expenses which Detroit Edison incurs in developing atomic energy be reflected in its rate?

Mr. CISLER. No, it will not be reflected in its rates. We expect to carry this cost out of our existing income.

May I explain that there are two parts of this plant, the reactor part of the plant, which is owned by the Power Reactor Development Co., and the conventional part of the plant which is owned by the Detroit Edison Co.

The reactor part of the plant is that part costing about $40½ million and the conventional part of the plant is that costing approximately $14 million.

The conventional part of the plant will become a part of the capital plant of the company, but the contribution of $6,250,000 into the reactor plant is charged out as an expense and not as a capital item and a reading of the Michigan Public Service order will, I think, make that clear, sir.

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Chairman ANDERSON. Mr. Cisler, may I go back to the Public Utility Holding Company Act. I said we would try to give you some assistance on it.

Your testimony indicates that this is just to make sure that none of these people are subject to the Public Utility Holding Company Act by reason of the participation, design, or construction or operation of an experimental reactor.

The language is that:

> No company shall be deemed to be an electric utility company within the meaning of this section if its only connection with the generation, transmission, and distribution of electric energy is the ownership or operation, whether in whole or in part, directly or indirectly, of a facility for the production of heat from special nuclear material which heat is used, directly or indirectly, in the generation of electric energy.

That would mean that you could have a generating station that would go on for a hundred years after it ceased to be an experimental reactor and that ownership of a portion of that stock would not subject anybody to the Holding Company Act.

I am not sure that it carries out exactly what you have been discussing in your statement. I think if you want to get it to cover an experimental reactor only, it might be easier to get out of the committee than this provision which, it would seem to me, exempts all electric generating stations where nuclear power was utilized from the operation of the Holding Company Act. It is quite a bit broader than experimental work.

Mr. CISLER. I think the intention here was that during this developmental period when you must have broad participation in order to carry out these expenses, and the fact that this plant is divided into 2 parts, 1 part which produces steam, and the other producing electric energy, it pertains only to the part of the plant that is concerned with the use of nuclear materials in the production of steam and not electric energy.

Chairman ANDERSON. I just thought if the bill was somewhat broader than you need maybe it would be wise to take the first step first and cover the experimental work in which you are now engaged and then if at a later date it seems desirable, because of the size of nuclear powerplants, that their operation should not be subject to the Public Utility Holding Company Act, that could be considered by the Congress.

Maybe this can pass as it is, but it would seem to me that Congress would take a pretty careful look at anything that would forever exempt from the Public Utility Holding Company Act the ownership of nuclear powerplants.

Mr. CISLER. I do want to make it clear that the only purpose of this is to permit this developmental work to go forward and because this reactor produces steam which, in turn, of course, is used for the generation of electric power, but under different ownership.

Chairman ANDERSON. Thank you.

Mr. CISLER. The other matters of concern to us are as follows:

Expenses for reprocessing of spent fuel, both core and blanket, have given Power Reactor Development Co. much concern.

It seems that these are:

1. Difficult to determine in terms of their basic elements; and
2. Reflect cost characteristics of plants presumably built for noncivilian application.

Also the losses of fissionable material within the aqueous systems involved are a matter of concern.

In view of the foregoing, the Power Reactor Development Co. is endeavoring to negotiate a sliding scale of processing charges which would take into account increased charges commensurate with the better operating performance of our reactor which we expect after a few years' experience.

In our negotiations with the staff of the Commission, one of the questions remaining relates to the date when interest charges shall commence on nuclear fuels furnished by the Commission. We ask that this date be fixed as the starting date of operation of the reactor, the same as is being offered in the announcement of the second round of power demonstration reactors.

Representative COLE. Should there be any great time spread?

Mr. CISLER. I don't believe that there should be, Mr. Cole.

Representative COLE. As to the interest charges on the use of the special nuclear material, I don't understand your term interest charges. Do you mean the fee for it?

Mr. CISLER. Yes; the interest of 4 percent charged for the special nuclear materials belonging to the Government and in the possession of the reactor owner. That is a use charge for the material which the Government owns.

Representative COLE. Is it a considerable period of time between the time when the material leaves the Government's possession and is installed in the private reactor? Is that a longer period of time?

Mr. CISLER. Well, the period of time may be quite long because, first, the material has to be fabricated into the fuel elements, then it is in the reactor, radiated, then taken out of the reactor, then it has to go through a cooling period, then transported back for reprocessing and again be refabricated.

Representative COLE. My question is: What is the period of time between when this material leaves the Government's possession and is turned over to your possession and is inserted in the reactor?

Mr. CISLER. That may be several months, sir, during the fabrication of the fuel.

Representative COLE. Twelve months?

Mr. CISLER. I say several months, but it may be as much as 9 months before that material is returned to the Government for reprocessing.

The CHAIRMAN. You want to pay the interest on it only during the period when it is actually being utilized by you in the operation of the reactor?

Mr. CISLER. Senator Anderson, the Commission has announced that it would waive interest during a period of time for the materials in the possession of the reactor company.

In the case of the large power demonstration reactors that period of time begins sooner than the operation of the reactor, whereas in the case of the smaller reactors the period begins, I believe, when the reactors are ready.

Chairman ANDERSON. You would like to have the conditions the same, particularly you would like to have the conditions which apply to small reactors apply to all reactors?

Mr. CISLER. Yes. In other words, starting date, the period of time which is when you have something coming from the reactor. It is just that we wish to bring attention to that difference.

We regard as especially significant, the constructive and exceedingly helpful approach shown by the Atomic Energy Commission and its staff, including Argonne National Laboratory and its personnel.

We sincerely appreciate the genuine desire of those skilled people to be helpful, and to continue the encouragement given private industry by the enactment of the Atomic Energy Act of 1954. By their cooperation they have contributed greatly to our objectives.

May I take this opportunity to express to your committee the thanks of all of us for your understanding and help in our endeavors to bring to America, and to the world, the use of nuclear fuels for the generation of electric power which can be produced at equal or lower cost than from fossil fuels or hydraulic energy, and thus be competitive with existing sources of energy.

I have brought this model of the breeder reactor plant which we are undertaking. It is the result of more than 5 years of work in research and experimentation and development. I thought you would wish to see it.

Chairman ANDERSON. Would you like to have the exhibits which accompany your prepared statement put in the record?

Mr. CISLER. If we may, sir.

(The exhibits referred to follow:)

EXHIBIT A

ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

Electric power systems:

Alabama Power Company
Atlantic City Electric Company
Baltimore Gas & Electric Company
Boston Edison Company
Central Hudson Gas & Electric Corporation
Cincinnati Gas & Electric Company, The
Cleveland Electric Illuminating Company, The
Connecticut Light & Power Company, The
Consolidated Edison Company of New York, Inc.
Consumers Power Company
Detroit Edison Company, The
General Public Utilities Corporation
George Power Company
Gulf Power Company
Hartford Electric Light Company, The
Jersey Central Power & Light Company
Long Island Lighting Company
Metropolitan Edison Company
Mississippi Power Company
NEGEA Service Corporation
New England Power Company
New Jersey Power & Light Company
New York State Electric & Gas Corporation
Niagara Mohawk Power Corporation
Pennsylvania Electric Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Electric & Gas Company
Rochester Gas & Electric Corporation
Toledo Edison Company, The
Wisconsin Electric Power Company
Wisconsin Power & Light Company

Other industries:
Allis-Chalmers Manufacturing Company
Babcock & Wilcox Company, The
Bendix Aviation Corporation
Commonwealth Associates, Inc.
Ford Motor Company
General Motors Corporation
Jackson & Moreland
Pittsburgh Consolidation Coal Company
Southern Services, Inc.
United Engineers & Constructors, Inc.
Vitro Corporation of America

EXHIBIT B

POWER REACTOR DEVELOPMENT COMPANY

Companies which have signified their intentions of becoming members, and to make necessary contributions:
Alabama Power Company
Allis-Chalmers Manufacturing Company
Babcock & Wilcox Company, The
Burroughs Corporation
Central Hudson Gas & Electric Corporation
Chrysler Corporation
Cincinnati Gas & Electric Company, The
Columbus and Southern Ohio Electric Company
Combustion Engineering, Inc.
Consumers Power Company
Delaware Power & Light Company
Detroit Edison Company, The
Fruehauf Trailer Company
Georgia Power Company
Gulf Power Company
Holley Carburetor Company
Iowa-Illinois Gas & Electric Company
Long Island Lighting Company
Mississippi Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Rochester Gas & Electric Corporation
Southern Services, Inc.
Toledo Edison Company, The
Westinghouse Electric Corporation
Wisconsin Electric Power Company.

EXHIBIT C

STATE OF MICHIGAN

Before the Michigan Public Service Commission, in the matter of the application of The Detroit Edison Company for directions as to the accounting treatment for disbursements made or expenses incurred in the design, construction and operation of a developmental atomic power reactor.

D–1282A–55.1

At a session of the Michigan Public Service Commission held at its offices in the City of Lansing, Michigan, on the 23d day of March A. D. 1955.

Present: Hon. John H. McCarthy, Chairman; Hon. William B. Elmer, Commissioner; Hon. Maurice E. Hunt, Commissioner.

ACCOUNTING ORDER

The application of The Detroit Edison Company for directions as to the accounting treatment for disbursements made or expenses incurred in the design, construction, and operation of a developmental atomic power reactor having come on to be heard before this Commission in its hearing room in the City of Lansing, Michigan, on the 14th day of March 1955, and proofs having been presented by petitioner and the Commission at such hearing, and this Commission being fully advised in the premises, as follows:

1. That special nuclear fuel is another source of heat energy which may under proper conditions be used in place of the old fossil fuels (coal, gas, and oil) in the production of steam that may be used in the generation of electric energy; and

2. That the petitioner herein has been engaged since late in 1950 in study, research, and development, having as its objective the construction of an atomic power reactor for the generation of electric energy. Such study, research, and development have been carried on in common with other electric power and industrial companies now being, with the petitioner, 33 in number. The personnel so engaged includes nuclear physicists, nuclear chemists, power engineers, and others possessing technical knowledge and skills deemed necessary; and

3. That the private electric power companies of this State have an obligation to be informed about and familiar with technological changes and advancements that may ultimately lead to the generation of electric energy from new sources at a cost at least comparable to, or lower than, the courrent cost of producing electric energy by the use of the old fossil fuels, and that Account 801 of the Uniform Classification of Accounts prescribed by this Commission expressly provides for research and development work intended to benefit the public dependent upon a given utility for service; and

4. That while the research and development work relating to the use of nuclear fuels differs from the research and development work carried on by the petitioner and others in the past, it is a difference in subject matter, but not in nature.

The problem is essentially one of controlling the heat energy from another natural resource found in great abundance on both private and public lands. The research and development efforts in the past have been directed toward the improvement of all elements of electric production and distribution facilities intended to bring about a reduction in the cost of electric energy.

The present electric rates when compared to the past reflect the success of such research. It appears from the testimony produced by petitioner that a full and complete study and investigation has been made of all types of reactors; namely, the nonregenerative, the converter, and the fast neutron breeder reactor. That study and the advice of experts preeminently qualified, compel the conclusion that the fast neutron breeder reactor holds the greatest promise for ecnomic success and the subsequent addition of an enormous new source of fuel.

The belief of petitioner has been confirmed by evidence submitted by the petitioner and from experts called by the Commission. All of this evidence points to the fact that the fast neutron breeder reactor offers the greatest promise of ultimately bringing about the economical generation of electric power by the use of nuclear fuels; and

5. That the testimony indicated that experience in the operation of reactors within this country over the past 10 years does not reveal any serious accidents or injury to workmen; in fact, the accident rate is far lower than that experienced in private industry generally; the fuel elements have none of the explosive possibilities found in military weapons; proper operation of a reactor in accordance with known and established standards will make relatively safe the location and use of such a reactor; and

6. That if the petitioner is successful (as there is reason to believe it will be), not only does this hold the promise of ultimately reducing the cost of generating electric energy, but, in addition, it will serve to retard greatly the depletion of the Nation's store of conventional fuels and increase their availability to others, and will likewise produce material needed for national-defense purposes, and for the operation of other reactors; and

7. It does not seem prudent for the petitioner, a utility, to await the time when manufacturers of equipment related to the generation of electric energy might be prepared to undertake the design and construction of a fast neutron breeder reactor; and

8. The early design, construction, and operation of a developmental reactor has been urged by the Atomic Energy Commission and the Joint Committee of Congress, only by construction and operation can there be actual test and proof of essential characteristics, such as:

A. Its economy of operation;

B. Adequacy of standards for operations without jeopardizing the safety and welfare of the public;

C. The status of its commercial possibilities; and

D. The nature and value of its byproducts.

9. That the results of such trial operation should lead to the subsequent design and construction of a commercial reactor which will bring about the generation of electric energy at a cost at least comparable to the current cost of producing electric energy by the use of the conventional fuels. The initial test or developmental fast neutron breeder reactor may then become obsolete after a relatively short period of trial operation as opposed to the useful life of present types of equipment.

10. That petitioner has been authorized by its board of directors to expend a maximum of $5 million over a 4-year period as its contribution toward the cost of designing, constructing, and establishing the initial operation of a developmental fast neutron breeder reactor, the aggregate cost of which is now estimated to be about $45 million; and

11. It is proposed to erect such experimental facilities at an early date upon lands within the service area of the petitioner; and

12. That the public interest requires encouragement by this Commission of the objective sought by petitioner to bring about the generation of electric energy at a reduced cost by use of nuclear fuels, which will also benefit the Nation as a whole by increasing the supply of usable nuclear fuels, and by reducing the depletion of other forms of natural resources presently occurring by reason of the increased use of the older forms of fuels.

Now, therefore, it is ordered: When petitioner expends or commits itself for the expenditure over a period of not more than 5 years, commencing July 1, 1955, a maximum of $5 million, then and in such event petitioner is authorized to reflect such expenditures as a charge against account 801 of the Uniform System of Accounts prescribed by this Commission when—

(*a*) petitioner has assurance satisfactory to it that there will be available from others when required, the balance of the total estimated sum required to—

(i) design and construct a developmental or test fast neutron breeder reactor; and

(ii) provide funds sufficient to operate such facilities for a reasonable period of time; and

(*b*) All licenses, permits, or other form of authorization required under the Atomic Energy Act of 1946, as amended, shall have been obtained.

[SEAL] MICHIGAN PUBLIC SERVICE COMMISSION.

By the Commission and pursuant to its action of March 23, 1955.

JOHN H. MCCARTHY, *Chairman.*

Chairman ANDERSON. Would you like to explain this model to us?

Mr. CISLER. This part of the plant is the reactor plant at an estimated cost of about forty and a half million dollars. It is a breeder-type plant which produces more fissionable material than it consumes.

This dome-shaped structure is for the purpose of confining any material that might be exhausted into the space that it contains so as to confine any gases or the like which might be released to the structure itself.

The actual fuel elements are at the bottom of the reactor. It is relatively small, but the heat release is very high indeed.

Chairman ANDERSON. You say relatively small. About how tall is that tower structure or glass structure going to be when it is completed?

Mr. CISLER. This is about 80 feet in height. But the reactor itself is much smaller than that. The heat energy released by the fissioning

of the enriched fuel elements is conducted away by liquid sodium and at a very high rate.

In turn that heat energy is transferred to a second coolant, sodium potassium, so as to screen out any radioactivity that the sodium carries from the reactor itself.

And the sodium potassium then gives up the heat energy which it carries over to water, and steam is produced in superheated form and the steam is then conducted over to the conventional turbine generator for the generation of electric energy.

The fuel elements are removed by means of devices here for that purpose.

After removal from the reactor they must spend a period of time to cool off, so to speak, before they can be transported to the reprocessing plant.

The reactor, of course, follows closely the work which has been done at the Argonne National Laboratory by the work there on EBR–1 and the work which is underway on EBR–2.

As I said in my prepared remarks, we have had very wonderful cooperation from the Argonne National Laboratory and its staff there.

The location of this plant is on the shore of Lake Erie in southern Michigan. The city of Monroe is about 7 or 8 miles away. This is a site which is suitable either for a conventional plant or for a reactor plant.

We are not there on the site taking test borings to determine the foundation conditions under the plant. We have, as I recited, this work underway. The actual reactor vessel that we hope to use in this plant is now being fabricated in the manufacturing plant. It will be installed in another location for part of the tests, and the tests on that will be completed when it is installed in the actual plant.

As I said, that experiment alone is at a cost of $4 million.

So we are moving forward even though there are these conditions which we have stated.

We are hoping that we are making progress.

Representative COLE. What is the structure of those maroon ribs just below the dome?

Mr. CISLER. These are more for the purpose of this model and for strengthening.

Representative COLE. You mean for this particular model?

Mr. CISLER. Just to give strength. In the ultimate this would be steel.

Representative COLE. Are those supports for the steel dome?

Representative COLE. Will the whole thing be steel down to the ground?

Mr. CISLER. It would be steel down as far as necessary in order to confine any gases.

Representative COLE. Then approximately half of the total height of the reactor shell would be encased in steel?

Mr. CISLER. Yes, and, of course, the reactor shell itself is of steel.

Representative COLE. The reactor housing?

Mr. CISLER. Yes; this would be the housing, and there is still more housing there in the center as well. So we have taken every precaution from a hazard standpoint, and we believe this would be a safe reactor.

Representative COLE. What comment do you have, if any, on the price which the Commission has fixed for the material which you expect to produce?

Mr. CISLER. That, of course, affects the economics. I think, Mr. Cole, it is more the cost of the reprocessing that we are concerned about.

Representative COLE. Then I judge you are satisfied with the price which the Commission has indicated they will pay you for the special material which you produce?

Mr. CISLER. Yes; we would accept that.

Representative COLE. You are concerned about the cost of reworking the fuel rods?

Mr. CISLER. Yes; separating that material out and reworking it. I have some descriptive booklets of this reactor.

Chairman ANDERSON. We will be very glad to have that, Mr. Cisler.

Representative COLE. Have you any criticism of the security classification which the Commission has given to reactor data?

Mr. CISLER. We have been getting along quite well, sir.

Representative COLE. You have no complaints, then?

Mr. CISLER. No, sir.

Chairman ANDERSON. Are there any other questions?

Thank you very much, Mr. Cisler. I hope that you will come back whenever you have any suggestions to make to us.

Mr. CISLER. Thank you very much, Mr. Chairman. It is a privilege to be here.

Chairman ANDERSON. I have a few things to put in the record. The Yankee Atomic Electric Co. has sent down a statement of views. I do not believe that I will read it. It has more to do with license and regulations, public liability insurance, waiver of use charges for demonstration projects, and things of that nature. A copy of that will be put in the record at this point.

Then I have a statement here from the Marufacturing Chemists Association dealing with the impact of the peaceful uses of atomic energy on the chemical industry. They would like to have that inserted in the record.

Westinghouse Electric Corp. has sent down a statement with reference to the hearings. That will be inserted in the record.

(The material referred to follows:)

YANKEE ATOMIC ELECTRIC CO.,
Boston 16, Mass., February 14, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR SENATOR ANDERSON: In response to your invitation, I should like to submit the following brief statement of views, with the request that it be included as a part of the record of the Joint Committee's 1956 hearings under section 202 of the Atomic Energy Act.

MCKINNEY REPORT

The report of the Panel on the Impact of Peaceful Uses of Atomic Energy has provided a comprehensive and stimulating review of the development, growth, and state of the atomic energy industry, of great value to the Joint Committee, the Commission, and the industry itself. It seems appropriate for individual comments such as this to illuminate particular aspects of the larger scene so excellently covered by the panel report.

YANKEE ATOMIC ELECTRIC CO. PROPOSAL UNDER POWER DEMONSTRATION REACTOR PROGRAM

At the time of the 1955 hearings, Yankee Atomic Electric Co. had been formed by a group of the major New England utilities to undertake the construction and operation of an atomic powerplant, the output of which would be purchased by the sponsoring utilities.

On March 30, 1955, Yankee submitted 1 of the 4 proposals received under the Commission's power demonstration reactor program. When its original proposal was found to be unacceptable, Yankee, on August 22, 1955, submitted a modified proposal involving a substantial change in design and capacity.

As modified, the proposal covers a pressurized water reactor and associated electrical generating equipment of approximately 134,000-kilowatt capacity, to be situated in western Massachusetts. The revised proposal increased the capacity of the plant by approximately one-third and was predicated on a different type of core, involving the use of stainless-steel-clad uranium oxide fuel elements, making possible a substantially improved core life.

This proposal was acted upon favorably by the Commission on February 8, 1956, and negotiations are now in progress with respect to the detailed contract under which Commission assistance in research and development work will be made available.

As presently scheduled, it is hoped that the plant will be in operation by early 1960.

DECLASSIFICATION OF RESTRICTED DATA

Our preliminary work to date has not been materially affected by any difficulty in obtaining access to classified data. As our program now moves into a new stage, requiring broader participation of our own personnel and wider contacts with other organizations, a restrictive policy in this respect would create serious difficulties and delays.

Accordingly, we are gratified that the Commission has already put into effect a general declassification program affecting substantially the entire field of reactor technology, and has accompanied this step by a simplified procedure for obtaining access permits.

We feel that the free exchange of technical information is of fundamental importance to the atomic-energy industry and hope that the Commission will be encouraged to undertake a continuing declassification program as rapidly as the need for military secrecy will permit.

LICENSING REGULATIONS

Since Yankee will be a licensee under the Atomic Energy Act, we have followed with particular interest the development of the Commission's licensing regulations. We have been gratified by the Commission's practice of submitting its proposed regulations to industry panels for comment and suggestion, and by the evident sincerity of the Commission and its staff in promulgating a realistic and workable framework for the atomic-energy industry.

While we are conscious that many detailed problems remain to be solved in the context of the new regulations, we feel that the groundwork has been soundly laid for future progress.

PUBLIC LIABILITY INSURANCE

We believe the major unsolved problem in undertaking the construction and operation of a demonstration power reactor lies in obtaining suitable protection against third-party liability in the event of an atomic disaster. As we pointed out in our statement in the 1955 hearings, it is virtually impossible for any concern to risk its entire assets in self-insurance against a possible atomic disaster, however improbable such an event may be. For a utility company to do so would, in effect, endanger its ability to continue to render normal service to the customers who are dependent upon it.

We have been gratified and impressed by the ability of the insurance industry to cope with the unknown problems involved in the operation of power reactors and by the progress which has been made during the past year.

To date it appears probable that the insurance industry will be able to underwrite, at a reasonable cost, all risks to the plant itself and to personnel employed at the plant, and, in addition, will be able to marshall capacity to deal with all but the most extreme situations of third-party liability, such as might arise from a

runaway reactor which ruptured containment devices and resulted in extensive offsite damage.

While the possibility of such a catastrophe is remote, it cannot be said to be negligible so long as human error is a factor to be considered in the construction and operation of a reactor.

While we feel that the present capacity of the insurance industry to cover these risks is more than adequate to justify our going forward with the preliminary stages of our program, we doubt that adequate protection yet exists to justify our undertaking major construction expenditures.

Accordingly, we concur in the recommendation of the McKinney panel and in the suggestions made in the course of the February 8 hearings, that the question of how best to obtain adequate protection at economically feasible costs in the event of an atomic disaster be more fully explored in order that policy can be set at the earliest possible moment.

WAIVER OF USE CHARGES FOR DEMONSTRATION REACTORS

As the McKinney report points out, Commission policy with respect to charges to be made for special nuclear materials can have an important effect on accelerating the demonstration phase of reactor development. Under the original power demonstration reactor program the Commission announced its willingness to waive charges for the use of special nuclear material for a period ending June 30, 1962.

Under the second invitation, for proposals covering smaller reactors, the Commission has announced its willingness to waive these charges for a period of 5 years from the issuance of the license so that in many cases the waiver would extend well beyond 1962.

In view of the time already elapsed during which the original waiver could be effective, it is suggested that a 5-year waiver is more nearly consistent with the Commission's objectives in offering limited assistance during the critical early years of operation of a demonstration reactor.

BOSTON REGIONAL OFFICE

The New England Governors' Committee on Atomic Energy, in its report of July 1955, recommended, among other things, that an administrative office of the Commission should be located in New England in order that closer and less costly contact with the Commission's programs may be maintained and New England interest presented more adequately in Commission operating and regulatory programs.

With plans now in progress for the construction in the New England area of a power reactor by Yankee, a major research reactor by Massachusetts Institute of Technology and a materials testing reactor by Nuclear Reactors, Inc., we believe a sufficient day-to-day worm load exists to justify the establishment of a Boston regional office.

In addition to servicing these major installations, the existence of an authoritative source of information on Commission practice and procedure would contribute importantly to the development of supporting industries in the atomic energy field.

Your very truly,

WILLIAM WEBSTER, *President.*

MANUFACTURING CHEMISTS' ASSOCIATION, INC.,
Washington 6, D. C., February 16, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
The Capitol, Washington, D. C.

DEAR MR. CHAIRMAN: On behalf of the board of directors of the Manufacturing Chemists' Association, Inc., I am pleased to submit herewith a written statement on the impact of peaceful uses of atomic energy on the chemical industry.

As you will note, the material contained in this statement is drawn principally from a survey conducted by our Atomic Energy Committee and participated in by more than 70 major chemical manufacturing companies. We believe that this information will be of direct interest to your committee in view of the hearings which you are now conducting.

We suggest that you may wish to include this statement as a part of the printed record of these hearings.

Up to the point where mass changes into energy, we are dealing with branches of chemical science. From the processing of the ores to the separation of the isotopes and the production of fuels for reactors, specialized chemical processes are involved.

Furthermore, it is impossible to think of the peaceful application of atomic energy without recognizing the very large part which must be played by the chemical industry.

We were not invited by the McKinney panel to conduct a seminar on the impact of peaceful uses of atomic energy on the chemical industry. Because of the contributions made by the chemical industry to date and the certainty that nuclear developments will have a definite impact on our industry, we considered the matter to be of sufficient importance to conduct our survey and to voluntarily supply the panel with the data received.

Such information has not been published in a public record to date, and it is for this reason that we feel our material would be both appropriate and valuable for your record.

Since we do not take substantive issue with the present policies of the Atomic Energy Commission, and have no specific recommendation for amending the Atomic Act of 1954, it was felt that this written statement would serve the purpose in mind without burdening your committee with oral testimony.

Respectfully submitted,

JOHN E. HULL, *President.*

The Manufacturing Chemists' Association is an organization of chemical manufacturers, founded in 1872, and consisting of approximately 150 corporate members. These members account for over 90 percent of the productive capacity in the United States for such products as organic chemicals; inorganic compounds, including acids and alkalies and their salts; plastic materials, gases, such as chlorine; synthetic fibers; pesticides, and thousands of other chemical compounds. We believe that the impact of the peaceful uses of atomic energy on our industry will be important, increasing, and continuing.

More than is generally realized, the chemist, the chemical engineer, and the chemical industry, played a major part during the early development of atomic energy, as well as in the subsequent weapons program. This is confirmed by the initial interest of scientists such as Hahn, Stresemann, Seaborg, and Urey.

Later confirmation came when the Manhattan District selected outstanding chemical companies—members of this association—to operate the major production plants required by the weapons program.

It is impossible to think of the peaceful uses of atomic energy without recognizing the very large part which must be played by the chemical industry. From the processing of the ores to the separation of the isotopes and the production of the fuels for reactors, we are dealing with chemical processes which will require specialized as well as ordinary chemicals for their operation.

The development of improved reactors necessitates the previous production of more stable construction materials.

Current trends toward high temperature operations, complicated corrosion problems, and the chemical processing of nuclear feed stocks and partially consumed fuel elements, emphasize the chemical industry's role in the nuclear field. The reprocessing of fuels is, in essence, a chemical purification which may require the development and production of new and better solvents.

The chemical industry will have to help settle the problem of utilization and/or disposal of radiation and fission products and the heat, byproduct of the production of economic power from nuclear sources. It is significant that current operating cost estimates of nuclear powerplants indicate that reprocessing will be the major cost item.

In order to provide an informed opinion on the impact of peaceful uses of atomic energy on the chemical industry, the Manufacturing Chemists' Association surveyed its members with respect to eight specific questions. Set forth below are the questions and summarizations of data received from a representative cross section of the United States chemical manufacturing industry.

Many of these firms are engaged in active nuclear research, and some in actual production operations. All have given the matter serious consideration in relation to their individual operations and areas of activity.

1. Will the impact of peaceful uses of atomic energy on the chemical industry be significant? Will new chemical markets result from byproducts or coproducts of nuclear processes?

Yes. The impact of the atomic energy development on the existing chemical industry has already proved itself to be not only real, but very important as well.

However, as the program develops, it is expected that changes will be evolutionary rather than revolutionary. It is still too new for one to be able to see all of its ramifications, even though some are already obvious.

Radioactive tracers will help to achieve a greatly improved control of many processes and products and will facilitate research determinations. Radioactive byproducts from the reactors can already be used to sterilize certain foods and pharmaceuticals.

It is becoming obvious to some that radiation will play a part in the production of new plastics. Radioactive pharmaceuticals are finding a rapidly growing place in diagnostic and theurapeutic procedures. The use of radiation to initiate and catalyze new chemical reactions is under intensive investigation. Production of special solvents to be used in purification processes will be important.

In connection with the foregoing and other examples not mentioned, the chemical industry is equipped to bring into play the basic know-how developed in commercial work over a period of many years for special problems in surface chemistry, catalysis, inorganic chemistry, materials handling, materials of construction, et cetera.

It is clear that up to the point where mass changes into energy, we are dealing with branches of the chemical industry.

In addition to the direct effects cited, there is an indirect one which will have a tremendous impact on the future planning of our industry. No longer will plants having high heat and/or power demands—aluminum, chlorine, caustic, et cetera—have to be located at sites convenient to cheap fuel or water power. Other considerations will become paramount. Furthermore, the expected lowering of atomic energy costs—which would appear to be inevitable—could well act to change the competitive positions of certain chemicals and structural materials.

"Energy where you want it" will change the geographical distribution of the chemical industry.

2. As peacetime uses develop, will there be new or expanded markets for chemicals? Will chemicals not now produced commercially be needed in tonnage quantities?

Yes. It is believed that uranium and thorium ore processing, and spent atomic fuel reprocessing, will require increasing amounts of acids, alkalies, fluorine compounds, chelating agents, ion exchange agents, precipitants, and extractants.

As the industry develops, many other chemical products such as plastics and reactor components will be required. There is little doubt that byproducts and coproducts from nuclear processes, not heretofore available or used in commercial quantities, will open up new chemical markets.

It is felt, however, that as direct markets due to peaceful application of the atom increase, these increases will be overshadowed by the indirect effect of nuclear energy in stimulating increases in the overall standard of living, and of consumption both here and abroad. In this increased business, the chemical industry would naturally share.

With regard to new products, the following should be cited:

Zirconium, hafnium, impervious high density graphite, radiogenic lead, heavy water, boral, and new heat transfer alloys and liquids.

In addition, the chemical industry will contribute to the production of strontium, rare earths, rare metals and salts, liquid metals, thorium, beryllium, and vanadium.

A more complete listing would be possible on a classified basis, but this would require an up-to-the-minute knowledge of nuclear processes.

3. Will radiation be a dominant factor, or just a useful tool or technique in the chemical industry?

It is believed that radiation will be a useful tool in the chemical industry. A small group believes that use of radiation may become a dominant factor in sections of, if not the entire, industry. Many members feel optimistic concerning the extensive use of radiation following further research and development work.

Specifically, there is interest in utilizing radiation sources for triggering chemical reactions. The use of isotopes and tracers, not insignifiant at present, should continue to grow and become an important tool to the industry. Use of such techniques will supplement rather than supplant present methods.

Radiation and isotope use should become important factors in the following fields:

Food sterilization, pharmaceuticals, medical—diagnostic and therapeutic—polymerization, and agricultural.

It is recognized that at present radiation from products or byproducts of nuclear processes is more expensive than that available from particle accelerators and other electromechanical devices. It is believed, however, that the cost of radiation energy from nuclear processes will eventually become economically attractive.

4. Will the demand for scarce materials for nuclear construction impede seriously the procurement of construction items by the chemical industry?

This depends upon several factors. The development of the nuclear industry caused considerable shortage of these materials, aggravated, of course, by the war conditions prevalent at the time and by the rapid rate of construction of nuclear facilities for weapon purposes.

The part which Government subsidy plays in the development and construction of nuclear reactors here and abroad will be a key to the rate of construction and thus to the availability of materials. The politicoeconomic atmosphere which provides the incentive for exploration and development of new materials will be a major factor.

In the light of the current status of the reactor program, it is believed that there will generally be a relatively minor impact on the availability of construction materials.

In certain categories such as high temperature ceramics and plastics, and instrumentation, for example, there will be more significant changes than in normal material, like steel and cement.

However, in a generally expanding economy the development of new material, methods of substitution, and new sources of supply will be hastened. The production of critical items for nuclear and other construction will probably keep pace with requirements over the next several years barring a national emergency situation.

5. Will the demand for technical manpower for the nuclear field compete seriously with the supply of chemists and chemical engineers?

Yes. The entrance of new competition for the inadequate supply of trained technical personnel must necessarily aggravate a situation which has already assumed serious, if not alarming proportions. It has been pointed out to us that there may be a tendency on the part of direct contractors to the Government to overstaff beyond normal commercial requirements.

The United States has established an Atomic Reactor School at the Argonne National Laboratory and a school for the study of radioactive istopes at Oak Ridge. Obviously, these two schools will attract many promising chemists and chemical engineers who otherwise might go directly into the chemical industry.

The industry in some quarters has noted the "appeal of the new and unknown" in contrast to the more prosaic types of science. One member has estimated that ten percent of the chemists and chemical engineers are now entering the nuclear field, and that this continuing demand will decrease those available for industry and teaching.

6. Is there a need for changes in existing chemistry and chemical engineering curricula to include courses in nuclear science?

We feel that drastic changes in the standard science courses would be both unwarranted and undesirable. On the other hand, such courses in chemistry, physics, engineering, and metallurgy, should probably be modified to include those portions of nuclear science which are pertinent to the particular courses.

We also believe that courses exclusively devoted to nuclear science might well be made available, possibly as elective for undergraduate students, but more as a field for graduate student specialization.

In general, it is felt that our colleges and universities are making satisfactory headway in dealing with this new challenge, and that the field of nuclear science, as such, should not have a major effect upon current fundamental training programs.

7. Is there sufficient freedom of operation of private enterprise in the nuclear field under existing security regulations?

The present administration and the Congress have made significant progress in furthering private enterprise participation in the peaceful development of atomic energy, through modifying security regulations and liberalizing patent policies.

Highlighting these efforts have been the Atomic Energy Act of 1954, the declassification program recently instituted, and the establishment of access

permits. These are all encouraging trends and if continued will contribute to a fuller participation by the chemical industry.

At the present time, the chemical industry, in a sense, is divided into two segments with regard to participation in peaceful developments of atomic energy. To one segment belongs those companies who have been engaged in contractual work with the Atomic Energy Commission and who, through this association, have gained an understanding of the security and patent regulations. These companies have gradually developed a method of operation so as to maintain reasonably effective research and development programs within the framework of such security and patent regulations as might obtain.

The other segment of the industry includes those companies who have had no association through contracts or working agreements with the Commission and hence have very little knowledge concerning the scope of the atomic energy program.

For this very significant segment, security classification and patent regulations are serious obstacles to their entrance into atomic energy activities. The fact that these companies have not until very recently had access to any information in the atomic energy field places them at a disadvantage.

The rapid development of atomic energy for peaceful uses can come about only when the full potential of the chemical industry is utilized. It is important, therefore, that security and patent regulations be so modified as to make research and development attractive to the entire industry.

To this end, declassification should continue at an accelerated rate and be broadened to the fullest extent consistent with national security.

Similarly, the patent regulations should be revised. Specifically, those provisions in the 1953 act which are unduly broad or ambiguous should be clarified—sections 151 and 152.

Other sections—153 and 154—should be omitted, and section 155 should be rewritten. The ultimate goal should be to return this field to conventional patent practices.

8. Insurance: In closing, we refer to another important problem which has already been recognized by the Atomic Energy Commission and affected industries—that of suitable insurance coverage for nuclear installations. This is a real problem, the solution of which will have a major impact not only upon the chemical industry, but upon all industries concerned with nuclear development. The problem is now the subject of careful study by various groups, and the chemical industry is anticipating an early and equitable solution in order to obtain a green light for further progress.

Conclusion: The personnel of the Atomic Energy Commission has shown a keep awareness of the needs of private industry, and has been genuinely interested in working out solutions to our mutual problems. This close liaison has made possible the progress to date, but closer and continuing liaison is both needed and expected.

Within the limits set by the weapons program, we believe that all information developed at Government expense should be made available to industry on an unclassified basis. The atomic energy field will grow and develop to its full potential only when it is completely exposed to the normal commercial incentives of private industrial development.

WESTINGHOUSE ELECTRIC CORP.,
Pittsburgh 30, Pa., February 13, 1956.

Hon. CLINTON P. ANDERSON,
Joint Committee on Atomic Energy,
The Capitol, Washington, D. C.

DEAR SENATOR ANDERSON: Thank you for your telegram of February 9, 1956, in regard to the hearings being conducted by the Joint Committee on Atomic Energy. The interest which the Joint Committee has shown in the problems of industry and in the views of its members is an important factor aiding the development of atomic energy today.

We appreciate the opportunity given to Westinghouse to be heard at this time, but believe that any matters which we might call to your attention are already well known to the Joint Committee. Needless to say, however, our company will be more than happy to provide any specific information which you or your associates may desire.

Sincerely yours,

CHARLES H. WEAVER, *Vice President.*

Chairman ANDERSON. Our final witness this afternoon is William S. Peterson, executive vice president of the Atomic Energy Committee of the American Public Power Association.

Mr. Peterson.

STATEMENT OF WILLIAM S. PETERSON, VICE CHAIRMAN, ATOMIC ENERGY COMMITTEE OF THE AMERICAN PUBLIC POWER ASSOCIATION

Mr. PETERSON. Chairman Anderson, and members of the Joint Committee on Atomic Energy, my name is William S. Peterson. I am the vice-president of the American Public Power Association and the vice chairman of the Association's Atomic Energy Committee. I am an electrical engineer by training and profession, and the general manager and chief engineer of the Department of Water and Power of the city of Los Angeles. I have been associated with this organization since 1922.

I have here with me, on my right, Mr. Alex Radin, general manager of the American Public Power Association.

On my left is Mr. James L. Grahl, who is a specialist that the American Public Power Association has employed to follow the progress of atomic energy and impart information to the members of our association.

The American Public Power Association, in whose behalf I am testifying today, is a national trade organization with headquarters at 1757 K St., NW., Washington, D. C.

Our association represents over 800 local publicly owned electric utilities in 40 States, Puerto Rico, and Alaska.

Membership of the association consists primarily of municipally owned electric utilities, but also includes public utility districts, State-owned systems, and a small number of rural electric cooperatives. No Federal power system, such as the Tennessee Valley Authority, or Bonneville Power Administration, is a member of the association.

American Public Power Association Interest and Activity in Atomic Energy:

I would like to begin by describing briefly our association's activity thus far in the atomic energy program and the general policies which we advocate in respect to atomic power development, and then proceed to more specific comments on the "Development, growth, and state of the atomic energy industry"—the subject of your hearing—with particular reference to the recent report of the panel on the Impact of the Peaceful Uses of Atomic Energy.

Our association has had a strong and active interest in the atomic energy program for a long time. We have been concerned about both the rate of technological progress in developing economically competitive nuclear powerplants and the national policies affecting the power industry.

Early in 1953, association representatives explored with the then Chairman of the Atomic Energy Commission, Gordon Dean, possibilities for participation by local publicly owned utilities in the atomic energy program.

Although we discovered that under then existing AEC policies we could not afford the large costs of such participation, the associa-

tion did establish an Atomic Power Policy Committee to make a continuing study of policy developments in this field.

Under the chairmanship of Samuel B. Morris, this committee has been very active and has submitted policy recommendations to the Atomic Energy Commission and developed testimony for presentation to your committee on several occasions. Our Committee, which is now called the Atomic Energy Committee, is presently drafting a statement of principles on "Federal Atomic Power Policy" for the consideration of the members of the association.

In the 12 months which have elapsed since our association last presented testimony before your committee, the local publicly owned utilities have been able to give more tangible evidence of their earnest desire to stimulate and participate in the rapid development of atomic power.

In response to the first invitation under the Atomic Energy Commission's power demonstration reactor program, the Consumers Public Power District of Nebraska, a member of our association, submitted a proposal to the AEC to build a 75,000 kilowatt nuclear powerplant of advanced design. This proposal has been accepted as a basis for negotiation with AEC, and it is hoped that a firm contract between AEC and Consumers Public Power District will be consummated in the near future.

Two more members of our association, the municipal electric systems of Piqua, Ohio, and Holyoke, Mass., have just recently submitted proposals to AEC to construct atomic powerplants of 12,500 and 15,000 kilowatts, respectively, in response to the AEC's small reactor demonstration program. Both the Piqua and Holyoke proposals are for plants of very advanced design.

Several other member systems explored actively the possibilities for submitting proposals, but found that the short time allowed and the many difficulties involved, and the costs, made it impossible or inadvisable at this time.

As further evidence of interest, I should mention that to date 15 member utilities of the APPA have obtained access permits from AEC.

In addition, the association last September established an atomic energy service and added a person to the staff to devote his time to keeping our member systems currently informed of major policy and technological developments in the atomic energy field of particular interest to the local consumer-owned utilities.

That person is Mr. Grahl, whom I introduced to you.

The members of our association look forward to contributing still more effectively in the years ahead to development of our atomic energy resources and to the establishment of sound policies designed to maximize their benefits to the general welfare of the people of the United States.

General policy: Before commenting specifically upon the recommendations of the McKinney panel and other matters, I should like to mention a few general principles which reflect the attitude of our association toward the development and utilization of atomic energy for the generation of power:

1. The principal objective of the local publicly owned electric systems is to provide their customers with more power at lower cost. Consistent with this principle, our association believes that high pri-

ority should be given to developing fissionable and possibly fusionable materials as potential sources of abundant low-cost power.

2. The more rapidly we can learn how to produce atomic power economically, the broader will be the energy base of our society and the greater the benefit to our standard of living and the public welfare generally.

3. Healthy competition between the publicly and privately owned electric utilities is the surest way to stimulate both segments of the industry to provide abundant supplies of electricity at minimum cost consistent with good service. We believe that policies which assure a continuation of this competitive situation in the atomic power field would be consistent with the principles underlying the private enterprise system in this country and very much in the interest of the consumers.

4. Our association very strongly advocates policies which will not only allow, but actively encourage competition in the electric utility, equipment manufacturing and related industries. Positive efforts must be made to devise policies to accomplish this or the large corporations with their great financial resources will continue to strengthen their already dominating position in this new field.

5. The United States Government, with due regard to the fact that the cost of research limits the participation and progress by private or local public agencies, should press forward also with a vigorous and determined program to develop nuclear powerplants capable of producing economic electric power as rapidly as possible and derive the maximum advantage from its own technical knowledge and progress.

This program should enlist to the fullest extent the efforts of the Federal Government working through its own agencies as well as through the instrumentalities of private industry, the electric utilities—both consumer and privately owned—State and local governments, institutions of higher learning, and other interested organizations under such circumstances of financing that they augment the program rather than constitute a bottleneck to development.

I believe that the meaning of these general statements will be made more specific by my comments on the recommendations of the McKinney panel. I have tried to organize these comments so as to correspond generally to the order in which the panel made its observations and recommendations.

Comments on the recommendations of the McKinney panel: Atomic power—Small and medium-size plants. We strongly endorse the panel's finding that:

> **The present development program is deficient to the extent that appropriate demonstrations of the small and medium-size types (of nuclear power plants) are not now underway. The urgency associated with accepting the challenge to United States world leadership, together with the need for establishing atomic energy as a power resource available to assist in maintaining maximum expansion rates of the American economy, require that effective development and demonstration of all major reactor sizes and types be carried forward at high priority. If progress is not expeditious and efficient, it is clear that the Federal Government has a fundamental obligation to carry it out. Although private participation in this program is desirable, it should not be obtained at the cost of delay.**

Chairman ANDERSON. Do you know whether or not in the first proposals they had most of them came from public power groups?

I understood they had some seven bids, they might be called, on small power plants and nearly all of them came from public power groups.

Mr. PETERSON. As far as I know, as to the recent bids, that came in by February 1, there were only these two public power bids, Piqua and Holyoke, Mass.

I would defer further to my staff here, if there is any change on that.

STATEMENT OF ALEX RADIN, MANAGER, AMERICAN PUBLIC POWER ASSOCIATION

Mr. RADIN. The two that Mr. Peterson mentioned are members of our association.

In addition, the city of Orlando, Fla., which is a publicly owned group, submitted a proposal. The three others are rural electric cooperatives and the seventh one was a university, I believe.

Chairman ANDERSON. Most all of them are public groups?

Mr. RADIN. Public or cooperative; yes, sir.

Chairman ANDERSON. Do you not think that is good?

Mr. PETERSON. Yes. That is very good.

We stressed the existence of this deficiency in the Commission's program in our testimony before this committee last year and on other occasions, and urged immediate steps to correct it. We are gratified that the Commission has made a start on the development of concepts suited to small and moderate size nuclear power plants, although it is ironic that the principal reason for the Commission's interest is the need for some reactors suitable for use in foreign countries, rather than any great interest in the small utilities of the United States.

The association has actively encouraged its members to participate in the AEC demonstration for small power reactors. It is most gratifying that two member systems were able to overcome the difficulties involved and submit proposals to the Commission.

The Commission now should proceed with dispatch to conclude agreements with these and the other utilities which have made worthwhile proposals, and expand and pursue with vigor the research and development that must be done before these and other plants can be built. Otherwise, the delays will accumulate and the program deficiency will continue.

In the interests of meeting urgent domestic and international needs, we suggest that your committee assure itself that this program is prosecuted energetically and effectively by AEC.

Rate of growth of atomic power: The panel forecast of atomic power generating capability in 1975 of 23 to 46 million kilowatts is disappointingly conservative. Higher estimates of the rate of development have been made by responsible and well-informed authorities, including W. Kenneth Davis, Director of the Division of Reactor Development of AEC.

In a speech of last April, Mr. Davis projected a possible nuclear power capability of 83 million kilowatts by the end of 1975, and 175 million by 1980, after analyzing the probable future growth of the electric power industry and progress in atomic power technology.

He remarked that his projection of the—

rapid increase in the building of nuclear powerplants within a few years emphasizes the new technological era which may be upon us.

Rather than gear our efforts and our policies to a conservative estimate of the growth potential of nuclear power, we would recommend that the higher estimate by Mr. Davis be regarded as a challenge and a specific objective. The United States can accelerate its progress toward economic atomic power if it decides to do so.

It is important that this country get on with the job of atomic power development and with all possible dispatch, not only because leadership is vital to our international position, but also in order to meet the soaring demands of our own economy for low-cost power.

As Mr. Reuther states in his stimulating and constructive separate opinion:

The supply of liquid and gaseous fuels is exhaustible. The ultimate supply of atomic energy would appear to be almost inexhaustible. Every unit of oil or gas that can be replaced by atomic energy in the generation of electricity is, from a national point of view, money in the bank. This will be true of coal also when we decide, as we undoubtedly will, to develop the technology of converting coal into liquid fuels.

Even now there is a scarcity of fuel oil for use on the Pacific coast that points to a national shortage of such oil.

I might interject here, that that statement is based upon our own recent experience in the Los Angeles Department of Water and Power where we are having great difficulty at the present moment in purchasing supplies of fuel oil. We only have at certain times 4 or 5 days' supply in our tanks and are buying on a hand-to-mouth basis and not on the basis of competitive bidding, but on an emergency basis.

I therefore urge that we set our sights high. Government and industry should both exert every effort to meet and surpass a goal of 100 million kilowatts of atomic power capability by 1977. This should be a minimum objective.

AEC Chairman Strauss recently termed an estimate of 80 million kilowatts by 1975 as too conservative.

Rate of progress toward economic atomic power: The panel's first recommendation is—

1. That the Congress, the American people, and the people of the world recognize that large sums of money and years of effort must be spent to bring atomic power to a point where it can be used effectively and widely on a competitive basis . . .

This statement may well prove to be correct, but it should be interpreted in terms of the use of money to reduce the years required and thus reflect the positive attitude with which this country tackled the formidable problems of developing the atomic and hydrogen bombs, and the nuclear submarine. The Government pushed these undertakings ahead with great energy, and a determination to overcome all obstacles as soon as possible.

Research, development, and construction were radically telescoped, with remarkable success.

The United States should not be more tolerant of delay and less interested in success in developing the peaceful applications of atomic energy than we have been in exploiting the military applications.

We do not advocate an extravagant "crash" program to develop economic atomic power, but we do believe that the United States is capable of progressing much more rapidly, on a prudent basis, than it is today.

The British, for example, with a smaller program and less extensive development facilities, will have a sixty thousand kilowatt nuclear power plant on the line in October of this year, well ahead of the first large United States plant, which is scheduled for completion in 1957.

The Russians plan to complete two million to two and a half million kilowatts of atomic power capability by 1960, according to a story in the New York Times of January 24, 1956. This is more than twice the expected United States nuclear power capacity by that date.

These are disturbing indications that the United States is not making a wholehearted effort to speed the day when atomic energy becomes a significant source of power.

Considering the extent of United States leadership in military applications, the size of our extensive research and development establishments and the financial resources of this country, the United States should clearly be well ahead in atomic power development instead of appearing, in at least some respects, to be falling behind other countries with lesser resources.

In spite of signs that we are lagging, the AEC budget for 1957 proposes less than a 4-percent increase in the cost level of its civilian power reactor development program. This would appear to be about enough to cover probable wage and salary increases.

On the other hand, AEC proposes an increase of 65 percent in the military reactor development programs. A total if $139 million is budgeted for operating costs alone for the military reactor programs; $38.2 million for civilian power.

The administration stresses "atoms for peace" in its public pronouncements, but the AEC budget emphasizes the military reactors. We believe that the budget should evidence a similar determination by AEC to speed the advent of economic atomic power.

The association urges your committee to exercise its great influence to stimulate a more energetic AEC civilian power program.

Government demonstration reactors. In its second recommendation, the panel stated:

> 2. That, in the event that industry does not take on the full risks and burdens, the Commission should support a program to bring atomic power to a point where it can be used effectively and widely on a competitive basis, even to the construction with public funds of one full-scale demonstration plant of each major size and type.

Although this recommendation is headed in the right direction, it seems somewhat ambiguous. For one thing, the implications of the introductory qualifying phrase are not clear. Industry is not proposing and is not able to shoulder the full risks and burdens of any of the demonstration plants so far proposed. All of the industry reactor proposals depend upon AEC research and development and some will require additional aid. Yet I doubt that the panel meant that these projects should be abandoned in favor of wholly Government-financed projects.

Secondly, the recommendation implies that the United States should wait and see what industry actually does. How long should we wait? The recommendation does not say.

We would be concerned if the Federal Government abandoned its responsibility to press ahead with atomic power development and turned over to the utilities and the manufacturers the power to decide how fast and how far we will progress in this field. Yet this is what will happen if the AEC decides to build no more large demonstration power reactors. These are generally recognized as an essential step to get economic power, no less essential than basic research and experimental reactors, and a great deal more costly.

We doubt that the private utilities have sufficient economic incentive or justification to build these first demonstration plants with optimum speed. Their incentive was described in the Wall Street Journal of August 22, 1955, as follows:

> Officials of the companies which make reactors say frankly that most of their utility company customers have no early expectation of cutting costs by building atom plants; their primary motive is to stake this out as an area of private rather than public power.

Having staked out the area by announcing plans, the private utilities are under no compulsion to go ahead with construction with great speed, nor can they prudently afford to do so.

That one can legitimately be concerned about when, if ever, some of the plants being proposed may be completed is indicated by remarks made by W. Kenneth Davis, AEC Director of Research Development at a press seminar last December 6. After describing the nuclear powerplants being proposed for construction, Mr. Davis said:

> This, then, is the large power outlook. If all of these plants come to fruition by 1962, there would be some million kilowatts of installed nuclear generating capacity. It is certainly too early to predict at the moment how many of these, other than the pressurized water reactor, will in fact be built. I certainly hope, and all of us hope, that all of them will be built.

This statement suggests that the AEC has turned over to private industry the responsibiity for deciding how fast we will progress in developing atomic power, how soon the American people are to benefit from this new source of energy, and how effectively we are to provide world leadership.

The publicly owned utilities also are very much interested in participating in some demonstration projects, but the speed with which projects proposed by our members can proceed is governed largely by the extent to which AEC will accept the risks and extra cost involved.

These nonprofit utilities do not have the financial resources or "risk capital" of the very large private utilities. The result is that the rate of progress on these projects is much more subject to AEC control than on the private utility projects where AEC financial participation is probably smaller.

As against the deliberate approach which a utility must take, the Government with its much larger financial resources can go ahead rapidly and energetically.

Thus, Admiral Rickover recently said of the AEC Shippingport reactor project that:

> We started constructing this plant in May of this year (1955). We expect to have it done in 1957. So you see that we are designing, developing, manufacturing, constructing, and building an atomic powerplant in generally less time than it takes to build a conventional powerplant.

Also worthy of note are the working papers in the Reuther statement, which indicate that as early as 1960 it might be possible to pro-

duce power from Federally financed nuclear plants that would be competitive in cost with conventional power in numerous areas of the United States.

Not only can the Government take more risks and move ahead more rapidly in the frontiers of this new field, but, we believe, it has a positive responsibility to do so. Concurrently, the public and private utilities can go ahead at their own rate of speed with the projects they propose to build.

There are many advantages to utility participation in early atomic power projects and we think that they should go ahead.

We do not think, however, that this is a situation where either Government or industry should be responsible for progress. If both go ahead, the Government can make sure that the program proceeds without delay, the utility industry can participate in development at an early stage, and solutions to the many difficult technical problems involved will be found much more rapidly than if an "either-or" policy is pursued.

We suggest, therefore, that in addition to the demonstration powerplants proposed to be constructed so far, the AEC also be authorized to proceed promptly with the construction of one or more large demonstration power projects to assure that this country progresses with optimum speed.

Chairman ANDERSON. May I stop you there and ask what you think of the proposal that was made, I believe by Senator Gore, that we construct a few plants across the country to serve as yardsticks, particularly in areas where we need power?

I think, for example, we may be running a little short of power at Oak Ridge and possibly one might be built there.

The New England States is a power deficit area and is an area of high rates. He thought we might scatter these across the country under the circumstances and see how they came out.

Mr. PETERSON. We are quite sympathetic with the proposal of Senator Gore. I believe we would say that the first possibility is that the Atomic Energy Commission can certainly build large plants for its own service because it is a very large power user.

Of next consideration would probably be the location of those plants in areas of high fuel costs. I think that is in agreement with our thinking.

Priority of atomic power development: As my remarks have indicated, we wholly agree with the panel's third recommendation:

> 3. That the urgency associated with this program requires that the technological resource of atomic power be fully explored with high priority.

Controlled thermonuclear power: The association believes, like the panel, that it would be highly desirable to maximize participation in the development of controlled thermonuclear power and to provide more information on its status to those considering investments in fisson powerplants.

Public and private attitudes and the control of information: The panel's comment on the need for a much better informed public opinion to guide our development of atomic energy seems very sound. This is essential to effective democratic control of the utilization of this great resource.

In line with this objective, I would offer comment pertaining to the matter of the separate statement by Mr. Walter P. Reuther. The Foreword of the report of the panel includes the statement that:

> The final step in the process was the detailed review of the report and agreement on it in the form in which it now appears.

From this it would appear that Chairman McKinney was trying to get the statement in such form as to obtain unanimous agreement thereto. With this objective and effort in mind, it can be understood why the chairman declined to include a statement of the Separate Opinion by Mr. Walter P. Reuther—

> * * * concurring with the report in general, but differing in conclusions and emphasis on particular points.

Without implying complete endorsement of Mr. Reuther's opinion, I would say that it is a thoughtful, competent, and challenging statement which presents ideas worth careful consideration by the public and by your committee. We recommend that your committee grant Mr. Reuther's request to include his statement in your record and include it in any report to Congress, or other publication which the committee may make of that report and appurtenant material.

The panel recommendations to ease security restrictions on reactor technology information, and to require AEC to compile in a usable form the data on peaceful applications of atomic energy are endorsed. These steps are very necessary to effective participation by organizations like the members of our association.

Research and development: In order to continue and accelerate the progress made so far in atomic power technology, the Federal Government should continue to make full and effective use of its extensive and elaborately equipped research and development facilities, for both applied and basic research.

At the same time, national policies should encourage research and development by private industry, educational institutions and scientific foundations, but without subsidies to such organizations except when the research results are available for the benefit of all.

There are more than enough problems to be solved to require the unstinted application of all of our public and private research and development resources to perfecting peacetime applications of atomic energy.

Hazards, protection, and insurance: The McKinney panel opposed a Federal atomic insurance program, except as a last resort, as representing a "threat to private enterprise."

The panel believed that it will be 2 to 3 years before any substantial private activity in the atomic power field can be delayed or stopped by an inability to obtain adequate insurance.

This panel statement assumed that utilities, private and public, and equipment manufacturers will be willing to proceed without delay in the construction of atomic power plants with no assurance that adequate insurance would be available when they were ready to go into operation.

I will be very much surprised if this turns out to be the case. All of the proposals made so far to the AEC are contingent upon the availability of insurance at reasonable costs. It seems to me that this problem will have to be solved rather soon or all proposed non-Federal atomic power projects will suffer delays.

It is not clear, either, why Federal insurance has to be a threat to private enterprise. The reverse may well be true, that private enterprise may be able to participate in insuring atomic power facilities only if the Federal Government provides or underwrites the protection against the unlikely, but very costly catastrophic type of accident.

We hold no brief for Federal insurance per se, but it appears to be the only method of avoiding protracted delays in constructing some non-Federal atomic power-plants.

At this point I would like to intersperse in my prepared statement some additional comment pertaining to our own Department of Water and Power.

Recently, we had occasion to enlarge the coverage of our department by including our water system as well as the previous inclusion of the power system in public liability insurance. The amount was of the order of $9,800,000 of insurance.

The type of coverage we are seeking is against failures of dams and the releasing of water in reservoirs, or other damage that water could do by being released from the system.

When the bids came in for such insurance, one bidder had gathered together sufficient underwriters to cover the complete amount. Another underwriter was quite perturbed because he could not find sufficient other underwriters to let him bid on the entire amount of less than $10 million.

That indicated that in this country there were not available sufficient underwriters with sufficient desire to write liability insurance of that character to accumulate $20 million.

That amount would not even be sufficient for one small plant in the atomic energy field.

Therefore, I have very serious doubts at the present time of the insurance companies being willing to take the rather unknown risks that go with atomic energy plants, which I am sure are certainly not less than the risks associated with a well-designed water system.

Financial environment: The panel made 8 recommendations under this hearing, but I will comment upon only 2. Recommendation 6 is that:

> The guaranteed price schedules for the production of special nuclear materials be declassified to make possible public examination of this important financial device.

As the panel report points out, these prices have a material bearing on the economics of atomic power, but they have been established in secret and are classified information. In the interests of adequate opportunity for public examination of such important price schedules, we would support the panel recommendation that they be declassified. Recommendation 8 is:

> The study prepared by the Department of the Treasury be examined as a valuable exposition of important and often misunderstood financial techniques.

One of the techniques discussed in the Treasury study is that of accelerated tax amortization. The study states:

> It provides a financial inducement in several important respects. Perhaps the most important consideration is the saving in interest cost realized by the taxpayer * * * business has the advantage of what is equivalent to an interest-free loan from the Treasury on the postponed (tax) payments. * * * Because

of their long useful life it should be of special benefit to atomic energy power developments.

This subject of accelerated tax amortization is of particular interest to the local publicly owned utilities because it has been the device used to funnel enormous Federal subsidies to the privately owned utilities.

At the same time that they have been receiving billions of dollars of benefits from this program, they have been unusually vocal in denouncing subsidized public power, and in parading themselves before the American public as "taxpaying" private business.

The fact of the matter is that the total benefits to the private utilities will exceed the entire investment made in Federal power projects over the past 50 years. One could hardly complain, assuming that this type of aid is essential to persuade the private utilities to build the capacity necessary for our economy, if these benefits were passed on to consumers served by these utilities. But, except for a few rare cases, these benefits are not passed on to the consumer. The consumer gets no benefit; these tax benefits represent enormous windfalls.

In connection with atomic power projects, the Duquesne Light & Power Co. received approval for fast tax writeoff of 75 percent of its investment in the Shippingport reactor project. By investing the tax savings realized at its normal rate of return, Duquesne will be able to recoup most, if not all, of its investment. Yet this fact is not reflected in the panel report showing Federal-private cost sharing in demonstration plants nor has general public notice of it been given otherwise by AEC.

We would urge that careful consideration be given to the use of fast tax amortization in connection with atomic power project principally because it has constituted a hidden subsidy of which the general public has been unaware.

If, nevertheless, it is believed essential in order to induce private investment in atomic power, then we urge very strongly that full public recognition be given to the fact that the taxpayers are providing this assistance and to the cost and the benefits involved.

In this connection, we believe that these costs and benefits should be reflected in any AEC announcements about the relative amounts of Federal and private financial participation in specific projects.

Patents: Under the provisions of the Atomic Energy Act of 1954, the Commission can by alert action provide for patent control and cross-licensing. However, section 153 (h) of the act states:

> The provisions of this section shall apply to any patent the application for which shall have been filed before September 1, 1959.

Under this provision, any patent applied for after this date, 3½ years hence, would not come under the control of the Atomic Energy Commission.

The schedules for power reactor development indicate it is not conceivable that developments in the industrial application of atomic energy will be accomplished so rapidly that the Government can abandon its present limited controls in this field so quickly without affording opportunities for the development of patent monopolies.

We urge your committee to recommend amendment of section 153 (h) to extend AEC controls for a longer period, by at least another 5 years.

In addition, to minimize the danger of patent monopolies being developed partly, if not largely, through the benefit of Government

expenditures, we also urge that the compulsory licensing features of the Atomic Energy Act be simplified and strengthened.

Government organization: We endorse the panel's recommendation's on Government organization, especially the recommendation that the AEC establish a "real focal point" within its organization for the development of peacetime applications of atomic energy. Organizational changes to give the peacetime applications program a priority, vigor, and cohesion similar to that displayed in the field of military applications seem necessary if we are to make optimum use of our resources to achieve economic atomic power at an early date.

We also urge your committee to direct the establishment of an office in AEC specifically to assist small business, including the small utilities, to participate in the peaceful applications of atomic energy. I will refer to this again later in my testimony.

Encouragement of competition in the atomic energy industry: Perhaps the most certain way to assure rapid progress toward cheap atomic power is to encourage vigorous competition in the equipment manufacturing, electric utility, and reactor byproduct utilization industries. A great deal can be done in this connection. On this score, I offer the following comments:

1. In the avoiding of monopoly, the Atomic Energy Commission, through the provisions of section 105 of the Atomic Energy Act, rests on the normal provisions of the various antitrust acts which are cited by reference. Provisions are set up whereby the Commission will establish liaison with the office of the Attorney General in the exchange of information.

These provisions would avoid the development of monopolies to the extent that the present laws are adequate.

It is the recommendation of the American Public Power Association's Atomic Energy Committee that the Joint Committee, in connection with its review of the act, make a more detailed study to determine the adequacy of the present antitrust laws with respect to the potentialities for monopoly involved in the development of atomic energy production and utilization.

2. In contracting with industry for the construction and operation of facilities, AEC has generally favored the large corporations. More recently, it has on occasion invited industry to participate in a manner resembling a competitive bid basis. Its demonstration reactor program contains this element. In so costly and uncertain a business as this is at present, the result may well be to favor unduly the large corporations which have enough financial resources to "bid" below cost and "buy their way in" to the atomic energy business. The result may be the eventual domination of the power reactor field by a few large corporations and a near monopoly situation.

In fact, the panel's power seminar reached this conclusion, stating that:

> There would no doubt be a tendency to concentrate the responsibilty for supplying nuclear power systems in the hands of a relatively few manufacturers.

The seminar seemed to regard this probability with equanimity, but it hardly seems conducive to vigorous competitive activity or consistent with the statutory policy to direct the development of atomic energy so as to "strengthen free competition in private enterprise." That is a quotation, of course, from the Atomic Energy Act.

One can also refer to the observation last October 10 by W. Kenneth Davis, AEC Director of Reactor Development, that—

*** * * we would like to have new contractors get into the business. The expanding program badly needs more contractors.**

We would, therefore, recommend that your committee urge upon AEC the necessity for contracting policies that will attract newcomers and will let the smaller businesses participate, even when they cannot afford to "buy their way in."

3. Our recommendation on patents, which I stated earlier, are aimed at providing better protection against patent monopolies, instead of waiting for them to develop, and this also would encourage the free play of industrial competition.

4. We also recommend that AEC be directed to establish a staff for the specific purpose of providing technical information, guidance, and assistance to small businesses, including the small utilities, interested in engaging in constructive activity in the peaceful applications of atomic energy.

At present, the small newcomer is confronted with a sea of confusing information and such a staff could be of real assistance. The difficulties are much less for the large corporations, which either have entree and experience through AEC contracts or get adequate guidance from their own large technical staffs.

This small-business staff could also devise and promote within AEC contracting policies designed to give the smaller organizations enlarged opportunities for participating in the AEC program.

Marketing of surplus power by AEC: In our association's testimony which was presented to your committee on February 10, 1955, the association's general manager, Alex Radin, described the problem being faced by the municipal utilities and rural electric cooperatives in availing themselves of surplus power which was to be marketed by the Commission in the future from an experimental reactor at West Milton, N. Y.

In the interval, there have been a number of developments in this situation. I will not attempt to recount them at this time, but I would like to point out that perhaps one of the most significant events which has transpired was the decision of the Commission to abandon its earlier plans to sell this surplus power to the highest bidder. Such a policy would have been completely contrary to the policies which have always prevailed in the marketing of Federal power, and this policy was therefore opposed by the local public agencies and rural electric cooperatives which have a preference, under section 44 of the Atomic Energy Act, in purchasing surplus power from AEC installations.

Although power from the West Milton reactor was ready for commercial use last July, satisfactory arrangements for marketing this power still have not been completed by AEC. The principal reason for this delay is that the preference customers can utilize this power only by completing satisfactory wheeling arrangements with the private power companies in the area.

The major private utility in that area—Niagara Mohawk Power Corp.—for some time did not make any offer to transmit the power to the preference customers, and it was only in late November 1955 that this company finally offered to wheel the power to one of the municipal electric systems—the Gas & Electric Department of Holyoke, Mass.—at a charge of $9 per kilowatt year, for a minimum of

2,000 kilowatts. This offer was later extended to the municipal electric system of Ilion, N. Y., the second municipal utility which has applied for a quantity of this power.

The unreasonable nature of the Niagara Mohawk Power Corp. wheeling proposal becomes apparent when it is considered that, on the basis of the output of the West Milton plant when it was operated for a 3-month period last year, the Ilion municipal system would lose $18,000 a year under the wheeling charges proposed by Niagara Mohawk.

As of February 1, 1956, both Ilion and Holyoke had made firm proposals to AEC to purchase a quantity of the West Milton power, and had been given until May 1, 1956, to conclude satisfactory wheeling arrangements.

During the entire period of negotiations for the marketing of the West Milton power, the AEC has adopted a "hands-off" policy in connection with working out wheeling arrangements, telling the preference customers in effect, that the Commission will sell the power to them, but that it is up to them to arrange for delivery of the power.

I recount this incident to your committee because I believe you will wish to give serious consideration to whether or not the present marketing provisions in section 44 of the Atomic Energy Act are fully adequate to implement effectively the policy of offering municipal electric utilities and rural electric cooperatives a preference in the marketing of surplus power from AEC installations.

Certainly, the experience to date has indicated that a private power company whose facilities are needed to transmit the surplus AEC power can thwart the intent of the Atomic Energy Act by its unwillingness to provide wheeling arrangements on reasonable terms.

Chairman ANDERSON. Thank you for that. We have been watching this and one of our committees in Congress has made a special study of this and the situation there has been called to the attention of the joint committee by several Members of Congress and we are watching the future contracts with a great deal of care.

I appreciate your calling this matter to our attention.

Mr. PETERSON. Dixon-Yates clause: In section 164 of the Atomic Energy Act, the Commission is authorized to enter into new contracts or modify or confirm existing contracts to provide for electric utility service. A single sentence in this section provided the basis for the much discussed Dixon-Yates contract. This sentence is as follows:

> The authority of the Commission under this section to enter into new contracts or modify or confirm existing contracts to provide for electric utility services includes, in case such electric utility services are to be furnished to the Commission by the Tennessee Valley Authority, authority to contract with any person to furnish electric utility services to the Tennessee Valley Authority in replacement thereof.

We believe this provision is foreign to the principal purposes of this act, which relate to the development, use and control of atomic energy. Experience demonstrates that it has seriously interefered with proper consideration of the atomic energy program by Congress and has greatly lessened public understanding of the more paramount issues in the development and use of atomic energy. Accordingly, it is urged that this provision be eliminated from the act.

Chairman ANDERSON. May I say that many of us tried to keep it out of the act in the beginning. I think if it had been kept out of the

act a great deal of difficulty that we had on the committee might have been avoided.

Mr. PETERSON. Yes. In conclusion, I wish to call your committee's attention to the recommendations submitted by our Atomic Power Policy Committee last year. These recommendations appear on page 420 of part 2 of the hearings conducted by your committee during the 84th Congress, 1st session, on "Development and growth and state of the atomic energy industry." Many of the points covered by our committee's report last year have been discussed above, but I would like to call your attention particularly to the recommendations under the headings "General welfare," "Disposition of energy," and "Charges for the use of special nuclear material."

For the information of your committee, I am attaching a copy of the resolutions on atomic energy adopted at the latest annual convention of the American Public Power Association.

On behalf of the officers and directors of our association, I would like to take this opportunity to express our appreciation for this opportunity to present the views of the American Public Power Association on the many vital issues facing your committee.

Chairman ANDERSON. Now Mr. Peterson, you mentioned resolutions on atomic energy adopted by your annual convention in 1955.

Do you desire those appended at the end of your remarks?

Mr. PETERSON. Those may be appended to my remarks and we will regard this as the method of transmittal.

(The resolutions referred to follow:)

RESOLUTIONS ON ATOMIC ENERGY ADOPTED AT THE ANNUAL CONVENTION OF THE AMERICAN PUBLIC POWER ASSOCIATION, MAY 3–5, 1955

NEBRASKA ATOMIC POWERPLANT

Whereas the application of nuclear energy to peaceful purposes as contrasted to strictly military uses has become a national objective; and

Whereas the byproducts possible of realization from the use of nuclear fuel for power production appear to open up unlimited possibilities for beneficial use in processing and preservation of agricultural and other products; and

Whereas private utility groups in association with industry and Government have been encouraged to proceed with several large atomic power developments which places such utilities in a position to dominate the field; and

Whereas the Consumers Public Power District, a public corporation and political subdivision of the State of Nebraska, has now filed a proposal with the Atomic Energy Commission for the construction of an atomic-fueled power plant in Nebraska within the scope of the participation program sponsored by the Commission: Now, therefore, be it

Resolved, That the American Public Power Association highly commends the pioneering spirit and initiative displayed by Consumers District in submitting this proposal.

SMALL ATOMIC POWER REACTORS

Whereas there are 2,300 publicly owned and 1,000 rural cooperative electric systems in the United States, nearly all of which are quite small; and

Whereas the unit cost of generation by these small utilities is much higher than in the larger systems, thus placing these small communities and farmers at a disadvantage; and

Whereas the primary effort of AEC has been directed toward larger reactors or smaller developmental reactors to provide information for large prototype reactors, leaving almost untested the field of the small reactor to produce power with maximum economy; Now, therefore, be it

Resolved, That the American Public Power Association urge upon the Atomic Energy Commission the importance of developing low-cost atomic reactors to produce electric power economically for units as small as 5,000 kilowatts.

LARGE-SCALE FEDERAL ATOMIC POWER REACTOR

Whereas the Atomic Energy Commission's own installations require millions of kilowatts and billions of kilowatt-hours and whereas the purchase of such power is a continuing cost to the nation's taxpayers; and

Whereas the AEC and its experts confidently expect that ample new sources of power may be produced through atomic fission or fusion at low cost; and

Whereas the construction of a large, full-scale atomic reactor to produce at least 100,000 kilowatts would afford a useful development and demonstration of the economy of such large-scale reactors and a yardstick to gage the cost of privately financed but publicly subsidized power reactors; and

Whereas there is urgent need for national leadership in the international race for economic goals in production of atomic energy for peaceful purposes: Now, therefore, be it

Resolved, That the American Public Power Association urge upon the Congress of the United States that it authorize the AEC to construct an atomic powered electric generation plant of not less than 100,000 kilowatts to furnish a portion of the power requirements of AEC's own installations, and to further explore and demonstrate the economy of large-scale central station production of atomic power.

Chairman ANDERSON. Thank you very much.

May I say that your organization has been one which has uniformly come and given us a serious presentation of your point of view. I appreciate it. I believe that if more associations would take advantage to come and try to present a public point of view at these hearings it would be greatly to the benefit of the American public. I want to commend you for the thought that has gone into this paper and for the constant advice and suggestions that have been given to us by your association.

Mr. PETERSON. Thank you very much.

Chairman ANDERSON. I have had the benefit of a number of letters from Mr. Radin and others which are to the point and which are clear and informative and which present a point of view which I think we need to keep in front of us and I want to take this chance to say publicly we appreciate that.

Mr. PETERSON. We appreciate your remarks, and we appreciate the opportunity to appear before you.

Thank you.

The CHAIRMAN. Thank you, Mr. Peterson.

Statements from witnesses not wishing to, or unable to appear will be inserted at this point.

(The communications referred to follow:)

CHAMBER OF COMMERCE OF THE UNITED STATES,
Washington 6, D. C., February 24, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Washington, 25, D. C.

DEAR SENATOR ANDERSON: The Chamber of Commerce of the United States firmly believes that the best interest of all the American people will be served by expanding the role of competition in atomic energy development so that maximum benefits can be brought to everyone.

Control over atomic energy information for other than military uses should be further relaxed to a degree consistent with preserving national security, so that private industry and initiative may transform the power of the atom for constructive rather than destructive purposes.

The government has done, and is doing, an excellent job of developing atomic energy for military purposes in time of crisis. Now, however, the government should declassify certain of this information for use by commercial firms. The basic consideration should be the added rate of progress from declassification, rather than the rapidly decreasing value of broad secrecy. This need became

particularly evident as a result of the recent Atomic Energy Conference in Geneva.

The national chamber believes that licenses and materials should be granted by the Atomic Energy Commission on as wide a base as possible. So far as practicable, the application of such licenses should be long-term and general, rather than specific.

Private industry should be granted personnel security clearances adequate to insure that private development will proceed on a fully informed basis. It is gratifying to note that progress in this direction already is being made under the Commission's access permit arrangement.

A greater utilization of atomic energy in fields such as medicine, agriculture, and industry, to mention a few, could be realized if individual entrepreneurs vie for consumer favor in the free market.

The chamber believes that greater private participation in developing the uses of the atom is being deterred by the patent provisions of the Atomic Energy Act of 1954. Section 152 denies an individual the right of obtaining a patent on an invention relating to atomic energy if he has had any relationship with the Atomic Energy Commission. If any such relationship exists or has existed, the invention is considered to have been made by the Atomic Energy Commission and the patent must be issued to the Commission as an agent of, and on behalf of, the Government.

The Atomic Energy Commission has apparently taken the position that, according to this rather loose wording of the Act of 1954, even permits for access to restricted data may conceivably come within the scope of a "relationship" with the Commission. We recognize, however, that in this event, the Commission currently waives its rights to patents arising out of information supplied to access permits. The national chamber takes the position that section 152 of the Atomic Energy Act of 1954 should be appraised with a view toward spelling out the exact intent of Congress in this area.

Section 153 of the act of 1954, providing for compulsory licensing of patents, inventions and discoveries, is basically inconsistent wth an inventor's proprietary rights in the result of his enterprise. Such patent provisions are subject to compulsory licensing during the entire 17-year life of the patent. This concept of limiting the patent rights of an individual seems to be contrary to the historical development of normal patent rights, which have as a basis for their adoption and development the very Constitution of the United States itself. It has long been recognized in the economic growth of this Nation that a person or firm should be rewarded for his inventiveness, initiative and his willingness to assume the risks involved in a new venture. For this reason, we urgently suggest that Congress reconsider the patent provisions of the act to the end that this inconsistency with the historical development of normal patent rights be corrected.

I would appreciate it if you would make this letter a part of the record of your current hearings.

Cordially yours,

CLARENCE R. MILES.

PENNSYLVANIA POWER & LIGHT CO.,
Allentown, Pa., February 14, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
The Capitol, Washington, D. C.

DEAR SENATOR ANDERSON: I received your telegram calling attention to the statutory hearing which the Joint Committee on Atomic Energy is holding February 14–18 suggesting my appearance and presentation of my views on the development, state and growth of the atomic energy industry. I appreciate the invitation but will be unable to appear. The following are, however, certain comments on the subject which I have tried to state most briefly.

As you may know, we are engaged with Westinghouse Electric Corp. in a program of joint development of a homogeneous type reactor to be designed for use with a power plant of 150,000 kilowatt capacity. In view of this background of our own activities, my opinion is necessarily confined to the utilization of atomic energy for the production of electric power as we now see the situation. At this time, we believe that the progress which has been made in this area certainly appears all that could possibly be expected. In our own efforts, the cooperation and assistance of the Atomic Energy Commission has

been splendid and most effective. Recognizing the tremendous job the AEC has had to do since passage of the 1954 Act, it is my considered opinion that the progress made has been astounding.

In this connection, I wish particularly to point out that the national laboratories of the AEC have done tremendously important and helpful work in advancing knowledge and technology to present levels. Continuation of such work is, in my opinion, indispensable now and for the several years ahead when the great emphasis must be placed on effecting a break-through to the economic generation of electric power by nuclear means.

Naturally, we have read with interest the report of the special panel on the impact of the peaceful uses of atomic energy. In our judgment, the panel did an outstanding job and in general we agree with the important recommendations which were made by the panel. We were particularly interested, as is all industry, in the matter of insurance coverage. In this respect, our present development program has not reached a point where it is possible for us to formally evaluate the extent of the potential hazards involved and the practicability of obtaining insurance. We would expect that our further work will in due course bring us to the point of reasonably definite conclusions as to the desirability or necessity of legislative change to meet the insurance situation. At that time, we would certainly expect to present our views to your Committee.

I appreciate the opportunity provided by you and your Committee to submit our comments.

Yours very truly,

CHAS. E. OAKES, *President.*

CONSUMERS PUBLIC POWER DISTRICT,
Columbus, Nebr., February 14, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Capitol Building, Washington, D. C.

DEAR SENATOR ANDERSON: I appreciate the invitation to submit suggestions to your committee relative to the atomic energy program, and in accordance with your permission, these are being conveyed by letter.

To identify myself, I am Ray L. Schacht, general manager of the Consumers Public Power District (of Nebraska), a member of the Atomic Energy Commission's Utility Advisory Committee, past president of the American Public Power Association, and a member of its atomic energy committee; however, the views herein expressed are my own, as general manager of Consumers District, and are not intended to reflect those of the other associations. You will recall that the Consumers Public Power District's proposal for the construction of a 75,000 kilowatt sodium graphite type of atomic power reactor has been approved by the Atomic Energy Commission, and we are now working on the contract documents covering that project with the Commission. The views herein expressed are in a large part the result of studies under our study team agreement and access permit, and experiences gained in submitting a proposal on the initial 60,000-kilowatt power reactor (awarded to Duquesne Power & Light Co.), and later on the 75,000-kilowatt sodium graphite reactor (SGR), mentioned above.

First, may I say that in our dealings with members of the Atomic Energy Commission staff over the past approximately 3 years, we have always received courteous, prompt, and understanding assistance on all requests to them, realizing full well that on some points there were no completely satisfactory answers available.

INSURANCE

Recent press dispatches indicate considerable progress by the insurance industry in making adequate insurance available for public liability and property insurance on nuclear reactors for commercial production of power.

In order that the insurance companies might have as complete information as possible on the sodium graphite reactor proposed by Consumers District, a 2-day information session was held in Los Angeles on June 15 and 16, 1955. At that time a very complete presentation on all features of the reactor was given to representatives of five large insurance companies by North American Aviation, Inc., the developer and proposed constructor of this type of reactor.

Although we have kept in close touch with these insurance companies since that time, no information has been made available at this date, from any source,

giving definite coverages and rates for either public liability or property insurance, in connection with our proposed reactor. Our organization anticipates proceeding with actual reactor construction in 1956; however, the insurance features now appear to be a major obstacle to such construction. There is no assurance that actual construction can proceed without some form of Government coverage, at rates which will not defeat the objective of producing power from nuclear reactors at competitive costs as promptly as possible.

FUTURE PROPOSALS

The objectives of the power demonstration program are well known and need not be repeated here. In the recent invitation for proposals on construction of power reactors, the Commission has given recognition to the fact that, at the present state of development, power is not available from atomic-fired powerplants at costs generally competitive with conventional fuels, and the Commission will consider furnishing of assistance to help defray the excess costs. This is a laudable approach, as otherwise the program could become self-defeating and be slowed down materially if not stopped entirely. Only a limited number of electric utilities can afford the luxury of this early development work without assistance from the Federal Government.

The alternate then becomes complete construction and operation by the Federal Government, if the broad objectives are to be met.

UTILITIES ADVISORY COMMITTEE

As the power demonstration program moves forward through the planning stage into the construction stage and later into operation, it is reasonable to assume that old problems will reappear in new form and new problems will arise.

The Electric Utility Advisory Committee, or some comparable group, could render valuable service to both the Government and to the utilities by increasing its activity in an advisory capacity to the Atomic Energy Commission and its staff in the formulation and review of procedures for licenses and permits covering construction, operation, use of fuel, health and safety, and similar matters.

I trust the above viewpoints may be helpful to your committee in its review of this important subject.

Very truly yours,

R. L. SCHACHT, *General Manager.*

ATOMIC DEVELOPMENT MUTUAL FUND, INC.,
Washington, D. C., February 16, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Senate Office Building, Washington, D. C.

DEAR SENATOR ANDERSON: Thank you for your inquiry of February 7 as to whether I would care to appear before the committee in regard to the hearings on the development, state, and growth of the atomic industry. Instead, I am submitting the following brief comment for the record.

It appears to me that the industry, on the whole, is moving ahead with amazing rapidity, considering the difficult problems with which it was faced. The record indicates that the Atomic Energy Commission has made a good measure of progress. Although there are many restrictions, some of which are still burdensome, a great improvement in this area is noticeable.

Examples of the ways the atomic sphere has been opened to the aggressive activity of private enterprise include:

(1) The first contract has been let for the manufacture by private industry in privately owned plants of fuel elements for reactor use.

(2) A program has been initiated under which private industry may, for the first time in its own facilities, produce uranium salts.

(3) Requests have been made to private industry to supply a total of 1,200,000 pounds of zirconium metal annually.

(4) A request has been made to private industry to supply up to 100,000 pounds of beryllium metal annually.

(5) Private industry has been extended an invitation to build and operate plants for the chemical reprocessing of irradiated fuel elements.

I have no doubt that the suggestions of the joint committee have been salutary in their effect on the Commission's progress, both as regards the entry of private industry into the atomic arena and as regards the related matter of classification of nuclear technology. On the whole, I think it would be considerably easier for a businessman to get into the atomic business than for "a camel to pass through a needle's eye." I am personally acquainted with a very considerable number of instances of the former, and, so far, despite my most diligent efforts, I have not come across a single instance of the latter.

There is, however, one acute sore spot which is afflicting the industry, and which has spread into the investment field—which reflects the state of the industry. I refer, of course, to the uranium price guaranty which is scheduled to expire April 1, 1962. The uranium industry, of course, like any mining industry, is engaged in the business of annihilating itself, as it depletes its wasting asset, the uranium mines already discovered. In order to stay alive, the industry must be continually fed by new discoveries to replace those mined out. Despite its many vicissitudes, by and large, the uranium industry has grown beyond the wildest prophecies and now contributes to the national interest. Necessary additional discoveries will not occur unless prompt action is taken with respect to the vacuum which, though it will not occur until 1962, will make itself felt with increasing strength in 1956. As you are well aware, a man or a company may take several years to find something, another two or three years to develop the property, and a year or two more to get into production. No one will pursue such a course, and spend money pursuing it, unless he knows there will be some kind of market after his prospecting, exploration, and development activity has been completed.

The Government has seen fit, and no doubt with justification, to make private ownership of uranium illegal. The Atomic Energy Commission must be induced to press ahead with a solution to this problem, whether it takes the form of an extension of the present ore price guaranty, a guaranteed price for concentrate, or a quantity guaranty. That the last would not be much of an innovation is shown by the fact that a combination of the last two has been used in Canada to supersede, in effect, the underlying open but lowerpriced guaranty for concentrates.

There have been statements by responsible parties some years ago that "We will have bomb material running out of our ears." Whatever may be said of such a statement at the time it was made, it would appear that the statement is being misinterpreted in the light of the current situation, where we find ourselves with a whole family of atomic weapons in addition to aerial bombs, with a clear indication that atomic weapons have tactical application as well as their previous strategic application, and with military propulsion obviously at the inception of a period of radical expansion. It would appear the height of folly to allow a domestic uranium mining industry to sicken and die, even apart from the enormous peacetime potential which uranium will have sooner or later. Even though the death of the industry in terms of actual production is six years away, it will as inevitably occur as if it were next week, unless some kind of action is taken. Needless to say, the feeling on the part of persons active in the uranium mining industry is reflected in the markets where uranium securities are traded. A deeply juaundiced view of the wildcat "penny" uraniums has spread even to the solidly established, well-organized uranium companies. This condition has been accentuated by a wave of depressing speculation, founded on rumors that we will soon be able to "burn a pail of water", or that uranium is obsolete because of a new wonder metal, thorium.

Such uninformed speculation, of course, is harmful to the future of uranium, and further delay by the Atomic Energy Commission is not in the national interest.

The direct demands of national security, coupled with the incalculable political importance of maintaining our world leadership in atomic affairs requires that either Congress or the Atomic Energy Commission do something about uranium. Too much time has been spent by the AEC in passing the buck to the Defense Department and to the Congress. It would appear that the Joint Committee of the Congress, in turn, has an obligation not simply to pass the buck to one or both elements in the executive branch.

Yours sincerely,

NEWTON I. STEERS, JR., *President.*

(Whereupon, at 4:30 p. m., Thursday, February 16, 1956, the committee recessed until Thursday, February 23, 1956.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

THURSDAY, FEBRUARY 23, 1956

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 2 p. m., pursuant to call, in the Old Supreme Court Chamber of the Capitol, Senator Clinton P. Anderson (chairman of the Joint Committee) presiding.

Present: Senators Anderson (presiding), Pastore, Gore and Jackson; and Representatives Durham, Cole, Hinshaw, Price, Van Zandt and Patterson.

Chairman ANDERSON. The Joint Committee will come to order.

I think it would be well, first of all, to make an explanation of what seems to be an unusual situation here, in that we have Mr. Murray appearing at a subsequent time.

At the time the general hearings were held, we had a rather tight schedule for a great many presentations. We had, as I pointed out at that time, a rather voluminous report, and Mr. Murray had requested the other Commissioners not to be involved in the presentation of that report, and had indicated in a letter to me that he desired to be heard at a subsequent time.

That is a little different procedure than we have had, but I knew he had some points of view with reference to reactors probably that he would like to present, and did not want to break the continuity of the general presentation made by the Chairman and General Manager and other members of the Commission.

I do hope the press will understand this is merely an additional session of the regular 202 hearings, with an opportunity for a dissenting member of the Commission to present his points of view on those parts of the Commission's report to which he dissented.

Mr. Murray, is that apparently a fair statement?

STATEMENT OF THOMAS E. MURRAY, A MEMBER OF THE UNITED STATES ATOMIC ENERGY COMMISSION

Mr. MURRAY. It surely is, Mr. Chairman.

Representative COLE. I was not aware that Mr. Murray dissented to any part of the Commission's report.

Chairman ANDERSON. I think if you will check the first part of the hearings, you will find that he did.

Representative COLE. I know he wanted to express his own viewpoint, but I was not advised of a dissent.

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Chairman ANDERSON. I had a letter stating that he wanted to appear personally at another time, and this letter was from the other members of the Commission. Perhaps I had better read that paragraph:

> This material and the statements embodied in it have been approved by the undersigned, but are not the unanimous views of the Commission. Our colleague, Commissioner Murray, has informed us that he has not objected to the presentation of this statement in its present form, and that he goes along in principle, but he does not wish to be understood as not concurring in it in its entirety. He has stated that he prefers not to indicate to what portions of the material he objects or the nature of his objections, but that in due course, he will present his own views.

Representative COLE. Then it comes to an understanding of what is meant by "dissenting." Will you explain your position, Mr. Murray?

Mr. MURRAY. I do not think it is a dissent in the way that it is generally understood as a dissent. It is an enlargement of the program and an expansion of some of my ideas on how we should get on with this program. Therefore, I did not want to be bound by various statements in that general report that might forestall me from at this time making this statement.

Chairman ANDERSON. Proceed, Mr. Murray.

Mr. MURRAY. From my almost 6 years of association with this committee, I know that you are always ready to consider proposals that look to the constant improvement of our atomic energy program. Hence, I appreciate the opportunity to appear before you to present my views with regard to certain policies that, in my judgment, ought to guide future developments in the use of nuclear energy.

My chief purpose is to propose a program in the field of industrial nuclear power reactors. However, the problem of developing a sound policy in this new field is intimately related to the problem of our policy in the field of weapons. The reason for this is inherent in the paradoxical situation in which we presently find ourselves.

Over the years, the far-flung organization of the Commission, with the indispensable support of this committee, has brought the United States to a position of preeminent strength in nuclear armaments. The facts and figures I referred to this morning are cause for comfort, inasmuch as they demonstrate the security that this strength gives us.

But they are also cause for apprehension, inasmuch as they warn of danger ahead. From what we know about radioactive contamination resultant from nuclear explosions, we know that a sufficient number of these explosions would render the earth inhabitable. Therefore, the fact of this danger, and indeed, of lesser dangers, must be permitted to have significant consequences with regard to our future policies in the weapons field. I have given you my views on these policies.

However, our success in harnessing atomic energy not only creates dangers; it also opens up before us a field of tremendous opportunities. Atomic energy, as bombs, could indeed render the earth uninhabitable to man. But atomic energy in the form of industrial power could so renew the face of the earth that man would live on it more abundantly.

The opportunities that lie before us are likewise responsibilities, especially when they are considered in the total context of the world situation. The United States has a responsibility to take the lead in developing all the beneficent applications of atomic energy, but especially industrial atomic power at home and abroad.

A properly broad view of our own security interests, as well as a true sense of our bounden duty to the peoples of the world, urges us to discharge one of these vital responsibilities by launching into a vigorous power reactor program that will be adequate in scope to the demands of the situation that faces us. These are my recommendations:

1. That we adopt and adhere to a policy which recognizes that the establishment of a commanding lead in the atomic power race is a matter of urgent importance to the United States;

2. That as the first phase of a program to implement this policy, we plan to install at home and abroad, between now and 1960, power reactors capable of generating 2 million kilowatts; that we further establish, as the goal of the second phase of our reactor program, 10 million kilowatts to be installed at home and abroad between 1960 and 1965;

3. That primary responsibility for financing the first phase of this program be assumed by government; and that the manner of financing the second phase be left for later decision;

4. That the Commission continue its present efforts under the power demonstration program.

Before discussing these recommendations, I should like to review some of the history of the problem of power reactors. Early attempts to accelerate progress in this field had to be subordinated to the more urgent demand for nuclear weapons.

When the feasibility of obtaining power from one or more of the Savannah River reactors was explored, the Commission reached the conclusion that to obtain power from even one of these reactors would mean delays in weapons production. However, in 1953, when the Department of Defense caused one of our nuclear power reactor projects—the aircraft carrier reactor—to be teminated, I took action immediately to turn this cancellation to advantage. My idea was to convert this project into our first large civilian reactor, the Shippingport project.

In the end, I was able to put through this idea despite formidable objections. The central issue behind most of them concerned the economics of nuclear power. Many in government were of the opinion that no large industrial reactor should be constructed unless it gave promise of producing power whose cost would be within the range of that from conventional powerplants.

Some of those consulted by the Commission felt that this reactor should not be built unless its capital cost was less than $300 per kilowatt of electric generating capacity. The proposed project was described as one "that would send good money after bad."

The arguments against proceeding were unacceptable to me. Not to have gone ahead would have meant a delay of several years. It was clear that we had no basis in experience for estimating costs of nuclear power nor do we have such a basis even today. My position was that we would only obtain reliable cost data by actually building and operating power reactors.

My chief conviction, then as now,was that the national interest urgently demanded industrial atomic power with all possible speed. The Commission finally accepted my idea in April 1953. This decision to go ahead was fortunate because, as you know, the Shippingport project represents the only prospect we have of obtaining industrial nuclear power from a large plant in the reasonably near future.

Here is the place to acknowledge again the debt that this pioneering project owes to your committee. Without your active support, it would not have moved forward.

The Shippingport reactor represented the first concrete step toward the larger program that should have been undertaken. Not content with this beginning, I repeatedly urged actions looking to the acceleration of the civilian reactor program and also toward placing power reactors abroad. Just a few examples are in order.

In 1954, I suggested that this country proceed to build power reactors in foreign lands, and proposed Japan as a good place to start. At my instance, a Commission study of this proposal was submitted to the agencies most concerned. Its conclusions stated that such a project could be carried out, and that the estimated cost of power would eventually be comparable to costs of conventional power in Japan.

Commenting on a report prepared by the Commission late in 1954, for submission to another agency, I said that the—

net effect of many statements [in the report] is to convey an erroneous and misleading optimistic picture of the status of our power reactor program—

and that—

the most important single action required at this time is authorization of an immediate acceleraton of the AEC's power reactor development program.

In June 1955, I asked that the Commission consider adopting a definite goal for foreign power reactor construction and suggested a million kilowatts of nuclear power generating capacity within the next 5 or 6 years. Again, in October 1955, I urged the Commission, without success, to endorse without delay a specific proposal by the State Department to place a small power reactor abroad. As far as I know, no disposition has yet been made by the State Department of this proposal.

Our program with respect to power reactors abroad is well known to you. Our research bilaterals offer technical assistance and limited amounts of fissionable material. Financial support will also be provided. Our proposed power bilateral programs offer technical assistance and support in the form of fissionable material.

Educational assistance will be part of both programs. These programs, and our intended participation in an inter-national atomic energy agency, are all laudable, but are all only preliminary steps. They, alone, will not meet the urgent needs of the next 5 to 10 years in the field of power reactors abroad.

The United States is certainly off to a slow start in the race for atomic power. We are running with the field when we ought to be well out in front. Our present domestic program has in prospect only a token amount of industrial atomic power before 1959. Again, we have no firm assurance that the widely advertised 800,000 kilowatts, which are promised for 1959 and thereafter, will actually come into existence.

For example, the plans for the Pennsylvania Power & Light homogeneous reactor—listed as 150,000 kilowatts—are understood to be dependent upon the fact that construction would be economically justified. The proposal of the Consumers Public Power District of Nebraska—for 75,000 wilowatts—is contingent upon satisfactory results from a small experimental plant that is not yet in operation. We have no assured time schedules for any of this 800,000 kilowatts.

At the moment, our sweeping promises to the world concerning atomic power are in danger of going by default. My recommendations are designed to offer a remedy for this deplorable situation.

1. I recommend that we adopt and adhere to a policy which recognizes that the establishment of a commanding lead in the atomic power race is a matter of urgent importance to the United States. In 1953, and many times thereafter, I expressed the idea that—

hope for a peaceful future depends in no small measure upon early success in meeting the challenge of industrial atomic power—

and further, that we would not win the atomic power race—

unless, as a nation, we have as great a will to win it as we have to say ahead in the weapons race.

To win this race will not be easy. Our experience at the Geneva Conference last summer gave us a new respect for the capabilities of Soviet scientists. Qualified individuals have given it as their judgment that the Soviet team at Geneva was of first-class caliber. Some placed their competence in reactor development as second only to that of the United States. It was even suggested that a better Soviet team may have stayed at home in Russia. In view of everything we now know about Soviet abilities and announced intentions, we have small cause for complacency and much cause for action.

(2) My second recommendation is, therefore, more specific. I propose that between now and 1960 we install, at home and abroad, power reactors that will be capable of generating 2 million kilowatts. Nothing less than this amount would be adequate to the needs of the situation. The time schedule here is of importance as showing the urgency we attach to this program.

Of necessity, a program of this magnitude should be thought of in terms of a span of 10 years. I believe that we can and immediately must make definite plans for the first phase of the program—that is, the years between now and 1960. Planning for the second phase—the years 1960–65—can at least take the form of establishing goals of endeavor. A fivefold increase—that is, an additional 10 million kilowatts—would seem to me to be a reasonable goal for 1965.

(3) My third recommendation is that the entire basis of financial support for reactor development and construction be revised. The large-scale program concretely necessary during the next 5 years cannot be effectively carried through and completed on time if private industry is expected to bear the primary responsibility for financing it. Therefore, I propose that Government assume primary financial responsibility for the first phase of the new program.

Here I must make clear my position. I hold as a matter of principle that whenever a task can be satisfactorily performed by private industry, the fulfillment of that task ought to be left to private industry. This principle is basic to the American system of free enterprise. However, the question is, Can the concrete task in front of us in the atomic power field be satisfactorily performed by private industry alone, or with limited assistance from the Government?

It cannot. Not only is the cost too high and the time schedule too short; the immediate incentive that would make for the requisite urgency is presently lacking. At least for the present, this country is blessed with abundant conventional means of electric power production. This is the central fact that explains the reluctance of private

industry to enter, on a large scale and with a sense of urgency, into the new field of atomic power.

Private industry again gave some indication of its reluctance early this month. When the Commission issued an invitation to submit proposals for reactors in small and intermediate sizes—5,000 to 40,000 kilowatts—there was no response from private industry.

The general reluctance on the part of private industry cannot be explained, as some have suggested, by the lack of information on its part. Many of our outstanding companies, whose assets run into the billions, have been intimately associated with the Commission as major contractors over the last 10 years. These companies know everything that we know about nuclear reactor technology; in fact, most of our knowledge in this field was originally developed by them for us in our facilities.

It is not realistic at this time to expect that the resources of American private industry will be used in such a way as to compete on a tight time schedule with the immense public resources which the Soviet Union is prepared to pour into its nuclear power program.

There is the further question of the economics of nuclear power. Earlier this month, the Commission reported on its reactor program in hearings before your committee. This report was pervaded by the concept that the economics of atomic power are of greater importance than getting the job done at an early date. This is simply an extension of that viewpoint which would have found in economics the basis for a course of inaction on the Shippingport reactor.

For my part, I believe that the United States will not mount the necessary program and complete it within the requisite time schedule as long as the economics of the program is the decisive consideration. The decisive consideration must be the demands of public policy, that is, our need to maintain a commanding lead in the field of atomic power, and to this end to place power reactors in operation, in adequate numbers, at home and abroad, at an early date.

This is our fundamental problem—to carry through this public policy to a successful issue. The fundamental problem at the moment is not a matter of costs; the program I recommend would be sound even though the projected costs were more than double that of power produced in the United States. The reason is that public policy is the controlling factor here.

In thus giving considerations of public policy the primacy over considerations of cost, I do not mean to minimize the importance of costs. Obviously, our objective must be to develop reactors which promise power at a low cost. However, I repeat my belief that we shall reach this objective most surely and quickly by building and operating reactors. By doing this, we shall also develop the broad base in personnel and in facilities needed to support an expanding nuclear-power program.

Finally, it must be remembered that delay in getting on with an adequate program will itself prove to be costly. The cost of delay in remedying power shortages where they now exist in various parts of the world will be the certain loss of United States prestige. Delay on our part will also mean the enlargement of Soviet opportunity to exploit nuclear power as a means of bringing neutral countries under their domination. Furthermore, here in the United States, power

shortages have been predicated. Delay in providing against this day of shortage will also prove costly. The United States can better afford dollars than delay, for delay may, in the end, cost us far more than dollars.

In concluding this recommendation, I wish two things to be understood. First, the financial policy I am proposing in the reactor field between now and 1960 should be regarded as an interim policy, adopted in view of the emergency which confronts us and which can only be met by a pioneering effort on the part of the Government. My hope is that, by 1960, private industry will be prepared to assume total financial responsibility for the second phase of the power-reactor program.

Second, this interim policy will redound to the eventual benefit of private industry. Complicated engineering problems will be solved more quickly. Basic doubts about the technical feasibility of various types of reactors will be cleared up and, in a word, a solid basis in experience will be laid for realistic and profitable private-power programs.

(4) My fourth recommendation is that the Commission continue its present efforts under the power demonstration program. These efforts will be furthered by the adoption of the foregoing recommendations.

In conclusion, let me bring your attention back to the relation between nuclear weapons and industrial nuclear power. Our programs in both of these fields are directed to the same end—the furtherance of justice and peace. The most pressing problem that confronts us today is that of balancing these 2 programs in such a way that each of them individually, and both of them together, will serve this 1 common purpose.

Our weapons program serves the cause of peace by equipping us to defend the order of justice. In the long run, a vigorous program for peaceful uses of atomic energy will make the more important and lasting contribution to the cause of a just peace.

This program will help create the economic conditions throughout the world which are a necessary support of a just and peaceful world order. Moreover, as the benefits of atomic power are more and more widely shared, we may hope that the world will be penetrated by the conviction that God in His almighty power and goodness has given us the secret of atomic energy for purposes of peace and human well-being, and not for purpose of war and destruction.

Chairman ANDERSON. Mr. Murray, on page 2, your first recommendation, that we adopt and adhere to a policy which recognizes the establishment of a commanding lead in atomic power, raises a matter of urgen importance to the United States—don't you believe that, pretty generally, everybody is agreed on that as an important thing?

Mr. MURRAY. Well, everybody is agreed on it, but I don't feel enough is being done about it. I call your attention, Mr. Chairman, to the matter of urgent importance to the United States. All of my recommendations in this field are based on that assumption.

Chairman ANDERSON. You suggest, as the first phase of the program, that we plan to install at home and abroad, between now and 1960, power reactors capable of generating 2 million kilowatts.

Then you say further on—on page 4, I believe—that we ought to perhaps make that financing an obligation of the Government to some degree.

Mr. MURRAY. That is right. That is the first phase, between now and 1960.

Chairman ANDERSON. I think that is on page 6, where you say:

> My third recommendation is that the entire basis of financial support for reactor development and construction be revised. The large-scale program concretely necessary during the next 5 years cannot be effectively carried through and completed on time if private industry is expected to bear the primary responsibility for financing it. Therefore, I proposed that the Government assume primary financial responsibility for the first phase of the new program.

Should I conclude from that that the sort of present first phase that we have, in which Consolidated Edison of New York, and Commonwealth Edison of Chicago, and Detroit Edison of Detroit, and other groups, are trying to proceed with primary financing being raised by them—that that is not going to get the job done, in your opinion?

Mr. MURRAY. I believe so, and I am firmly convinced that they are not.

Chairman ANDERSON. Do you think there should be more Government financing in it?

Mr. MURRAY. I do.

Chairman ANDERSON. In the nature of Government ownership of these projects or Government participation to a greater degree?

Mr. MURRAY. Well, we might even follow the pattern that has been set down at the Shippingport reactor, where the Government owns the reactor and where the Government is selling heat to the conventional powerplant at the same price that it could have been produced in an ordinary, conventional, steam powerplant.

Chairman ANDERSON. I saw a recommendation, or a report, a while ago that that Shippingport power might cost as much as $52 mills. Surely, they are not going to sell it at more than a few mills, are they, if it is going to be sold in competition with other power?

Mr. MURRAY. The price of the Shippingport reactor is going to be very high. Some estimates are as high as you have just indicated, as 52 mills. We can see, of course, the day when that will be cut in half, or maybe down to one-quarter of the price.

Chairman ANDERSON. But there will be several of these reactors, if you followed along that theory, the Shippingport reactor, to follow through with that, would be 50 mills. You couldn't expect to sell that power for more than 8 or 10 mills, certainly.

Mr. MURRAY. That is right.

Chairman ANDERSON. Would the Government bear the loss of operation?

Mr. MURRAY. It would.

Chairman ANDERSON. As an experimental thing?

Mr. MURRAY. Yes.

Representative VAN ZANDT. At that point, will you yield? When you mentioned that the cost of power at Shippingport might reach as high as 52 mills, are you taking into consideration the revenue from the sale of power to Duquesne Light & Power, and also the revenue from the heat?

Chairman ANDERSON. I think that I used that figure, and I don't believe he did, but I have seen it in an article here recently.

Mr. MURRAY. I have heard that figure, the 52 mill figure, being used. We can project a type similar to the Shippingport reactor today and get in the range of 12 to 15 mills on paper, at least. That was the result of the report that was prepared after I made the recommendation to put a reactor in Japan.

It was indicated in that report that that reactor could produce power at a competitive basis with the cost of power in Japan.

Representative VAN ZANDT. The 52-mill figure confused me.

Chairman ANDERSON. Do you know anything about that 52-mill figure, Mr. Davis?

Mr. W. K. DAVIS (Director of the Division of Reactor Development of the Commission). That is the estimated cost of producing the power from the Shippingport reactor. It does not take into account the sale. There has not been any price deducted for the sale of power.

Chairman ANDERSON. We were not able to hear very well. Would you repeat that? It covers only what?

Mr. DAVIS. The 52 mills covers the total cost of generating the power from the Shippingport reactor with the first core that will be in the reactor, and it has not had subtracted from it the revenues from the sale of power to Duquesne Light.

Chairman ANDERSON. But if they were sold at 10 mills, or something of that nature, you would still have a 40-mill loss?

Mr. DAVIS. The sale price is 8 mills.

Chairman ANDERSON. Does that clear it up?

Representative VAN ZANDT. Yes, thank you.

Representative COLE. Based on 52 mills per kilowatt cost, what would be the capital cost of the project, per kilowatt?

Mr. DAVIS. This, I believe, is somewhere between 10 mills and 15 mills out of the total. I can't give you the exact figure.

Representative COLE. I haven't asked my question properly, or you didn't give me the answer. What is the capital cost per kilowatt of the entire Shippingport project which will result in an operating cost per kilowatt of 52 mills?

Mr. DAVIS. My guess is between 10 mills and 15 mills.

Chairman ANDERSON. I think his question is this: Is it $1,000 a kilowatt, as against $300, or is it $2,000?

Mr. DAVIS. I am sorry. The cost will be somewhere between roughly $450 per kilowatt to about as high as $775, depending on the exact output of the plant.

Representative COLE. Depending on what?

Mr. DAVIS. The output of the plant, which will be somewhere between 60,000 and 100,000 kilowatts.

Chairman ANDERSON. If it is 60,000, the cost may be $750, and if it is 100,000, it may be as low as $450?

Mr. DAVIS. That is correct.

Representative COLE. Does that per-kilowatt capital cost include all of the cost of research that went into the particular design for Shippingport?

Mr. DAVIS. It includes none of that at all.

Representative COLE. We have up here a chart which shows the capital kilowatt cost at Shippingport as being $370.

Mr. DAVIS. That would be the cost of the reactor portion of the plant alone, if it produced 100,000 kilowatts.

Representative COLE. Thank you very much.

Representative VAN ZANDT. May I ask Dr. Davis this question: The Shippingport plant, I think, is designed to yield 65,000 kilowatts of energy; is that correct?

Mr. DAVIS. It is designed to give a minimum of 60,000, and the turbogenerator being installed is 100,000 kilowatts.

Representative VAN ZANDT. Can you give us, in round figures, the return that the Government will receive? That is, when this energy is turned into the lines of the Duquesne Light & Power Co.?

Mr. DAVIS. I cannot, offhand, Mr. Van Zandt.

Representative VAN ZANDT. Can you, as far as the heat is concerned? I understand there is about 265,000 kilowatts of heat that you are going to dispose of that will bring the return of about 11 mills.

Mr. DAVIS. Our contract with Duquesne calls for them to pay us on the basis of the heat approximately 8 mills per kilowatt-hour that they generate from the steam. Now, if the plant were operated at a high operating factor, this would result in a return of perhaps $5 million or $6 million a year. That is maximum.

Senator PASTORE. May I ask a question there? Do you predicate your thesis that there should be greater governmental participation in the development of peacetime power on the premise that business has not or cannot meet the challenge of the rivalry we are confronted with on the part of Russia?

Mr. MURRAY. I base it on both assumptions.

Senator PASTORE. Could you be a little more specific about that? Do you think that private industry is equipped, as you know private industry in this country, and you are a man with a vast background in business—is private industry equipped in this country today to meet this challenge on its own?

Mr. MURRAY. Financially, you mean?

Senator PASTORE. Yes.

Mr. MURRAY. No, not the way I look at this challenge.

Chairman ANDERSON. When you say "No," do you mean from the standpoint of capital structure?

Mr. MURRAY. Oh, no.

Chairman ANDERSON. Do you mean from the standpoint of risk?

Mr. MURRAY. From risk.

Chairman ANDERSON. Obligation to their stockholders that they now have?

Mr. MURRAY. That is right.

Chairman ANDERSON. Do you mean only from the standpoint of the operating company? Supposing I take Commonwealth Edison plant; it would be only the stockholders of Commonwealth Edison, or would you involve, as well, the people who are going to build the reactor?

Mr. MURRAY. It might be a joint venture, of course, and both contribute something to the overall cost.

Chairman ANDERSON. I am thinking of products liability, more or less. Suppose Babcock and Wilcox, or Westinghouse or General Electric design a reactor in which there might be trouble. Do you think that that financial risk would keep them from perhaps building it when the time came?

Mr. MURRAY. As you have raised here in your previous hearings the question of insurance on an operation of this kind, it is vital, and it is all-important in these various companies. I do not believe they can go ahead until that insurance problem is settled.

Chairman ANDERSON. That is what I was trying to get at. Was your answer to Senator Pastore's question, when you said "No," that private industry wasn't prepared to do it, was it based only upon the size of the financial job, or upon the special hazards connected with it?

Mr. MURRAY. It is connected with their responsibility, primarily, to their stockholders.

Chairman ANDERSON. As you know, in OVEC and EEI cases, where they needed to build very large plants, they arranged financing running up into several hundred million dollars.

Mr. MURRAY. That is right.

Chairman ANDERSON. Now, these reactors aren't going to cost that much.

Mr. MURRAY. No, but those, of course, are conventional powerplants.

Chairman ANDERSON. That is what I am trying to get to. If it came in the OVEC plant to a cost of $1 billion, they could finance it.

Mr. MURRAY. There is no doubt about it.

Chairman ANDERSON. In the reactor that costs $45 million, they can certainly raise the money to finance that, if it were just to raise the money.

Mr. MURRAY. That is right.

Chairman ANDERSON. So there is another hazard that you think is involved when you say private industry financing can't do it.

Mr. MURRAY. That is right.

Senator PASTORE. There is more than that, isn't there, Mr. Murray? After, through conventional fuels you can produce conventional current for 3.5 mills, and here we are talking about 52 mills, there is a serious question what responsibility the directors would owe to their stockholders to invest money on a risk venture.

Mr. MURRAY. That is right.

Senator PASTORE. Without any immediate hope or prospect of return on their investments.

Mr. MURRAY. That is right.

Senator PASTORE. Isn't that fundamentally the problem that confronts us?

Mr. MURRAY. I think so.

Senator PASTOR. Unless Government steps in and meets the eminence of this challenge that we must meet, even on a world scale, aren't you of the opinion that this job is never going to satisfactorily be done.

Mr. MURRAY. I think the past 5 years has demonstrated that so clearly, that private industry is not prepared to do the job.

Senator PASTORE. Now, I was very much concerned, as I have said several times before—I was very much impressed with the enthusiasm that we received from private industry at the time we were considering the 1954 atomic law. Then, after the law was enacted, and then, of course, they were put in the position where they had to produce, although we have received some encouraging activity since that time, the fact of the matter is that it hasn't been quite enough.

I think fundamentally, it is because of the risk involved, and the cost of this current hiatus of atomic energy at this stage.

Mr. MURRAY. I think that is correct.

Representative DURHAM. Mr. Murray, in your statement here, you say up to the present time that the reactor program has been a two-phased program, primarily for building of weapons. This program as outlined here and as recommended by you, would it continue to be, in your opinion, a two-phased program as the program has been over the past several years?

I am speaking primarily in thinking of the weapons production, as well as the power production.

Mr. MURRAY. I think, as I have stated in the opening part of my statement here, that there is a relationship between weapons and power development, and there should be a balancing between the two.

Representative DURHAM. Then what you are advocating here, or as a proposal, is not entirely a power program; is that right?

Mr. MURRAY. I think this program would stand on its feet irrespective of any weapons angle to this situation.

Representative DURHAM. But it would be primarily for the production of power?

Mr. MURRAY. Yes, sir.

Representative DURHAM. In making up your proposal here, and, of course, we always have to necessarily think of the cost of the programs here in the Congress, because it is pretty hard to extract taxes—would you hazard a guess as to the cost of this proposal over the present program that we are carrying on at the present time?

Mr. MURRAY. Yes. I think I can do that.

Representative DURHAM. I don't expect you to be specific, but since we are into the discussion of it as a recommendation by a member of the Commission, I think that we should have at least some idea as to the cost of it.

Mr. MURRAY. I think at least $1 billion would be involved.

Representative DURHAM. $1 billion?

Mr. MURRAY. Yes, sir.

Representative COLE. Over 10 years?

Mr. MURRAY. No; in this preliminary stage. It is for the next 5 years.

Representative VAN ZANDT. Is the $1 billion in addition to the present $2 billion expended annually by the AEC?

Mr. MURRAY. Yes, sir.

Representative DURHAM. Would you try, or could you attempt to separate the recommendation as to the domestic program and the international program that you also carry in your recommendations here?

Mr. MURRAY. As you notice, I have just taken an arbitrary figure here to divide it between domestic and foreign. I should be inclined to favor the foreign programs because I think reactors can be placed in many parts of the world today that would be economical today and would continue to be economical.

Representative DURHAM. Of course, you are speaking of reactors that produce fissionable materials.

Mr. MURRAY. Yes, sir.

Representative DURHAM. And not primarily research reactors.

Mr. MURRAY. That is right. They are power reactors.

Representative DURHAM. Entirely; is that correct?

Mr. MURRAY. Yes.

Representative DURHAM. That is all.

Senator GORE. Mr. Commissioner, is it fair to conclude from your statement that under present programs and progress under present programs, the availability of large amounts of uranium would mean very little to atomic power in this country in the next several years?

Mr. MURRAY. I don't think I quite understand your question, Senator. You are speaking of the availability of uranium, and whether that would be a controlling factor?

Is that your question?

Senator GORE. My question is, if the present programs and the progress, or lack thereof being realized under present programs continue for the next several years, how will atomic power be facilitated within the United States by the making of uranium, or large quantities of uranium 235 available for that purpose?

Mr. MURRAY. Well, if we continue to use the uranium in power programs, I assume that the balance of it would go to our weapons programs, or to be stockpiled for future use.

Chairman ANDERSON. That doesn't get to the question.

Mr. MURRAY. I am sorry.

Seantor GORE. I will put it another way. You have told the committee, as I interpret your statement, that we are making very little, in your opinion very unsatisfactory, progress in the development of atomic power in the United States.

Mr. MURRAY. I follow you so far; yes, sir. That is right.

Senator GORE. In your opinion, would an actoin by the Commission in making available larger amounts of uranium 235 facilitate that program?

Mr. MURRAY. No.

Senator GORE. That is my question.

Mr. MURRAY. I am sorry.

Senator GORE. Then what would the availability of greatly increased amounts of uranium 235 mean to power programs in the United States, unless we have such a program as you recommend in your statement?

Mr. MURRAY. In the years ahead, none whatever.

Senator GORE. None whatever?

Mr. MURRAY. I don't think so.

Senator PASTORE. What Mr. Gore is getting at, I suppose——

Mr. MURRAY. It does help private industry to project programs for the future. It gives them an indication that there will be uranium available for the future, but for the next 5 years, saying that you have got lots of uranium available for the power programs, I personally don't believe that would help the program in the immediate years ahead.

Senator GORE. Do you recall that in 1954 we had a small legislative struggle in the Senate that lasted for 13 days and nights involving this question, and I am sure you do?

Mr. MURRAY. I remember there was a struggle there in 1954. I wish you would point it up a little differently.

Senator GORE. I would like to read you a provision of the 1954 Atomic Energy Act. By that, may I interpret, before I read, the Government's hands are tied. More legislation will be required before this great Government of the United States, with this vast amount of

uranium, with this great power resource owned by the people, can build facilities for the development and generation of power in commercial quantities?

I will read this: I am reading from section 201:

> There are hereby authorized to be appropriated such sums as may be necessary and appropriate to carry out the provisions and purposes of this act, except such as may be necessary for acquisition or condemnation of any real property or any facility or for plant or for facility acquisition, construction or expansion.

Legislation would be required, would it not?

Mr. MURRAY. I should think so.

Representative COLE. To do what?

Mr. MURRAY. To go ahead with this kind of a program.

Senator GORE. Then it would appear to me that we are right where we were before.

Mr. MURRAY. If I interpret what you have read.

Senator GORE. It would appear to me that we are right back where we were in 1954. This vast amount of uranium that is to be made available for the development of power, under present circumstances, would largely be for the benefit of other countries, perhaps in plants financed by our own taxpayers, but denied to our own people unless developed through the monopoly of private enterprise.

Now, do I understand your position that you favor the entrance of private enterprise further, and favor the further entrance and participation of private enterprise in the atomic power field?

Mr. MURRAY. By all means; yes, sir.

Senator GORE. Do you recommend this program as a means of facilitating that further participation?

Mr. MURRAY. I do; yes. I have stated that, and I think it has great advantage to private industry for us to get the answers in the next 4 or 5 years, plus the other advantages that it would have.

Senator GORE. Do you think it is necessary for the Government to pave the way, and to demonstrate the feasibility of methods and plant design and type in order to encourage and facilitate the entrance and participation of private industry in this field to a greater extent?

Mr. MURRAY. If a national policy is established that this has got to be done on an urgent basis, the answer is "Yes".

Senator GORE. Well, I repeat, Mr. Chairman, we seem to be back at the gates of 1954, and I would recommend that the committee start hearings on some legislation to untie the Government's hands in order that the American people may receive the benefit of this vast source of power now in the hands of the United States.

Chairman ANDERSON. Did you not say, Senator Gore, section 201? It was section 261, I think.

Senator GORE. I believe it is; thank you.

Senator PASTORE. May I just inject this observation?

Mr. Murray, the announcement of 20,000 kilograms being made available of U–235, recently announced by the President, domestically, and 20,000 plus 200 kilograms internationally, may have a cataclysmic effect, psychologically speaking, but it certainly won't have an effect from a practical point of view until we get going with this program of establishing the thing wherein you can burn this fuel.

Am I right on that?

Mr. MURRAY. I think so; yes, sir.

Representative COLE. On that point——

Mr. MURRAY. Mr. Cole, if you will pardon me, I read this statement in the morning's paper of the designation of 40,000 kilograms. That announcement is a big step forward toward achieving a goal of industrial atomic power, just for the reasons, Senator, that you just indicated.

This action was made on the unanimous recommendation by this Commission, and constitutes a firm indication of our intent to foster the development in friendly foreign nations of industrial uses of the atom. It also serves to assure our existing and pending licensees, as well as those who have submitted acceptable proposals, in the demonstration program, that the material necessary to carry out their programs will be available.

It is my belief that we must, however, do more to move ahead in this country, and as the leader in this field of atomic energy, bring the industrial use of the atom to all of the peoples of the world. It is a splendid step forward.

Senator PASTORE. It ought to be supplemented with a more expanded program on the part of the Government in getting the reactors built.

Mr. MURRAY. Just making the uranium available doesn't solve the question, as Senator Gore has indicated. There is a great deal more that must be done.

Senator GORE. Legislation must be passed, for one thing.

Representative COLE. I am happy to hear you give that expression of your viewpoint regarding the announcement of the President's allocation of uranium for foreign use. In answer to a question from Senator Gore, I got the impression that it was your attitude that this was an idle gesture on the part of the President.

Mr. MURRAY. I am sorry, Mr. Cole.

Representative COLE. I am happy to have the reaction from you that it is something very much more than that.

Mr. MURRAY. It is a great step forward.

Representative COLE. Because we recall in Geneva, last summer, the concern of the representatives of foreign countries who might be interested in obtaining a reactor—and they say, "Why should we renegotiate for a reactor, and why should we commit ourselves to buy a reactor and build one when we don't know whether we are going to get any fuel to put in it?"

Mr. MURRAY. That is right.

Representative COLE. That was causing concern and holding back the program. Now, that has been answered. They have been given assurance that fuel will be made available, and so I say that it is much more than an idle gesture.

Mr. MURRAY. Well, I am glad that you straightened me out and you out and the record out, if I have indicated anything otherwise.

Representative COLE. I think we all share your anxiety, in moving along as rapidly as possible, and it is a question of how rapidly should our program be.

Senator GORE. Would the Congressman yield for just a moment?

Representative COLE. I would like to at least finish my sentence, but go ahead.

Senator GORE. I want to also disabuse the Congressman's mind of any impression that I considered the President's statement or proposed action as an idle gesture.

I think it will have great meaning abroad. What I undertook to elicit from the Commissioner was that under the present programs, and the lack of progress thereunder, it would have little effect on the development of atomic power within this country within the next few years.

I certainly would not want the Congressman or anyone else to think that I referred to the President's statement or action as being meaningless. I think it does have great meaning and represents a step forward.

Representative COLE. Perhaps I misunderstood your interpretation, but I based it upon your expression when you said that we were right back where we were in 1954. With that I take issue, and I said we are not right back where we were in 1954, but we are away ahead in the early part of 1954 and we are far beyond what we anticipated in 1954 we would be in 1956, in my opinion.

Senator GORE. Would you yield there? Of course, we are ahead of where we were in 1954. For one thing, here is the announcement of the availability of large amounts of uranium. I will not go into the changes that have made that possible. I applaud that, but insofar as the development of atomic power in this country is concerned, I say that we are back about where we were in 1954.

The Government's hands are tied by the 1954 act, and this Congress should proceed immediately to untie the Government's hands in order that we can bring to the people the benefit of this vast source of power owned by the people.

Representative COLE. I agree with the gentleman, the Senator, as to whether the 1954 act tied the Government's hand in any respect. The Commission would still have had to come to the Congress to obtain the funds for any program, whether it is Mr. Murray's program or Commissioner Strauss' program or Representative Cole's program or Senator Gore's program. The Congress would still have to put an okay on whatever was proposed to be done.

But to get more to Mr. Murray's recommendations, it has always been my feeling, Mr. Murray, that in our anxiety to get ahead, we should proceed. Prudence requires we proceed with caution in order that whatever is done will be done permanently, and sure, rather than to act hastily and run the risk of inviting disaffection from abroad, and disappointment and disillusionment from investors here at home.

Do you know of any country which might be interested in atomic power at 50 mills per kilowatt?

Mr. MURRAY. I don't know of any, but I do know, and I used a figure here a while ago, that the reactor that we projected for Japan would bring that 50-mill figure that has been talked about here today down around 12 to 14 mills.

Representative COLE. Presumably there are many countries that would be interested in power at 12 mills.

Mr. MURRAY. I think so.

Representative COLE. But we have no assurance that atomic power will produce electric power at that cost, do we, other than calculations on paper?

Mr. MURRAY. Calculations on paper and the experience that we are getting as we go along in the various reactors.

Representative COLE. What was the size of the reactor you had in mind for Japan?

Mr. MURRAY. 100,000 kilowatts.

Representative COLE. You will agree, I am sure, that something more will be necessary in order to have a sensible reactor in operation in any foreign country than just to build them a reactor. The bricks and mortar and lead and uranium that go into the reactor are not the whole story by any means. To have a producing and operating reactor you must have an economy that will use the juice. You must have a personnel that knows how to assemble the reactor and operate it after it is made. You will agree to that?

Mr. MURRAY. No, not on the assembly of the reactor any more than you have to put these foreign nations in the building of turbines. You supply them with a turbine, and you show them how to operate it.

Representative COLE. You mean it does not require any special skill to assemble a reactor?

Mr. MURRAY. It does, certainly, but you would do it like you do in other foreign countries today, when you put in a conventional powerplant.

Representative COLE. Certainly with very few exceptions it is generally true there is no country abroad which has the skilled personnel to assemble a reactor, isn't that true?

Mr. MURRAY. Not exactly true. The question is what you mean by personnel. What they need is some supervision in order to put this there and that there.

Representative COLE. And you do need the skilled personnel to operate it?

Mr. MURRAY. You need skilled persons to operate it.

Representative COLE. Something more is needed than just the material that goes into the reactor. You must have personnel to go with it.

Mr. MURRAY. Certainly.

Representative COLE. For the most part most of the countries lack that personnel. So it is going to take some time to train a supply of skilled personnel in the reactor field. I have felt that the atomic program would proceed, but very little faster than the economics which would be involved in it, if any, depending on the location of the reactor. I calculate your program, Mr. Murray, would cost in the neighborhood of $6 billion for a 10-year program.

Mr. MURRAY. That is mostly in the second phase of it.

Representative COLE. Yes. And with no assurance that that investment of $6 billion would prove out to be sensible or economic in any respect. For my point of view, I doubt that the taxpayers are ready to gamble on such large stakes.

Mr. MURRAY. I think if they knew the whole story in atomic energy, they would.

Chairman ANDERSON. Mr. Murray, didn't you estimate only the first phase would be Government planning, and the other $5 billion would be privately financed?

Mr. MURRAY. That is right. I am hopeful it would be.

Chairman ANDERSON. If it was not prudent, the companies probably would not put in their money, it would not come to the taxpayer.

Mr. MURRAY. Mr. Cole, if you put this on the basis of economics,

and that is your only motive in going ahead, you don't go ahead in this business.

Representative COLE. It can't be based solely on the hard dollars and cents calculation of course, but when I relate 5 mills with 50 mills, then I think that is the extreme. If you can get it down to a ratio of perhaps 2 or 3 to 1, we might be justified in spending public money. When it is 10 to 1, I don't agree.

Mr. MURRAY. You would not have that calculation of 50 mills unless you build the Shippingport reactor, and that is the first core. Your second, third, and fourth cores will bring these prices down. That is how you get the economic power; you reach for it.

Chairman ANDERSON. Senator Jackson.

Senator JACKSON. Mr. Murray, I want to say first that I think what the President is doing, growing out of his announcement of yesterday, is very commendable. I want to say that some of us recommended it some time ago. On June 6—I just checked back in the record—I suggested to the Chairman of the Atomic Energy Commission at our meeting that we go into the power reactor programs. At that time, we were told that it was not possible. I think that that was a mistake. I think that we made a mistake here. I think we should have started on this power reactor program as far as our foreign policy is concerned sometime ago. Do you agree with that?

Mr. MURRAY. I do, sir.

Senator JACKSON. In order to clarify this cost problem in connection with the production of power, I would like to ask a few questions.

In essence, isn't this the setup: We can say that the automobile is expensive and the fuel is cheap. Is that a good analogy?

Mr. MURRAY. I think so.

Senator JACKSON. In other words, the reactor plant is expensive, it takes a lot of money. The fuel is cheap. It is in this area that there is public confusion.

Mr. MURRAY. I think it is; yes.

Senator JACKSON. Supposing I say 1 pound of uranium is worth around $20, the equivalent energy in coal is worth $10,000. One hears that statement. Naturally the question is why don't we have atomic powerplants all over. The point is, I take it, that your plant is expensive because you have to add together the cost of the fuel, and the cost of the plant. If you divorce them, you get an accurate picture. Is that a fair statement?

Mr. MURRAY. I think it is.

Senator JACKSON. The reason why a plant is expensive is that, No. 1, you have the problem of material that goes into the plant.

Mr. MURRAY. That is right.

Senator JACKSON. First to act as a shield for harmful radiation.

Mr. MURRAY. Yes.

Senator JACKSON. Then you have to have material that will not absorb too many neutrons; is that correct?

Mr. MURRAY. That is correct; and that is expensive material.

Senator JACKSON. That is the reason why the plant is expensive. No. 1 is the shielding material, No. 2 is a material that will not absorb any neutrons.

The second big problem you have is to get a plant in which you can control this energy properly. It is like a hydroelectric dam. If you

let all the waterpower over, you are not making effective control of that water energy, are you?

Mr. MURRAY. You are not; no.

Senator JACKSON. That is another reason it costs a lot of money. Then the next reason, would you say, is that you have this problem of disposal of the ash or the waste material.

Mr. MURRAY. Yes, sir.

Senator JACKSON. So when you add up all these things you have an expensive plant but you have cheap material.

Chairman ANDERSON. Not being a lawyer, I would not know what leading the witness was, but you go right ahead.

Senator JACKSON. I am simply trying to give some simple analogies which might be helpful.

Now, isn't it a fact that as of now it is not economically feasible to have atomic power in the United States when you compare it with fossil fuel and with hydropower?

Mr. MURRAY. That is correct, Senator.

Senator JACKSON. So logically you ask the next question; is it feasible abroad? Isn't it a fact that there are many areas in the world in which atomic power is economically feasible because of the high cost of fossil fuels and the nonavailability of hydropower?

Mr. MURRAY. I personally think that atomic reactors today could compete in many areas with the ordinary conventional abroad.

Senator JACKSON. I am talking about abroad.

Mr. MURRAY. Yes, abroad.

Senator JACKSON. When you add up the President's program, his suggestions are really feasible abroad. I am talking now about current capability.

Mr. MURRAY. I think it has greater application abroad than in this country.

Senator JACKSON. Until we can obtain control of hydrogen power, at least on the basis of what we know today, atomic power is a relatively expensive fuel in the United States.

Mr. MURRAY. Yes.

Senator JACKSON. So it does seem to me the importance of this effort is in the foreign field. That is why many of us advocated it a long time ago, and we were told we could not do it. I was confident that we could and I am sorry we didn't start earlier.

Now, let me ask this next question. Up to now we have been exporting the research atom and the passive atom in research. I hope that we can really go all out on exporting the energetic atom that will be able to produce electric power that can help establish industry in these backward countries, that will be able to help pump water and irrigate and to bring power to the homes of these underdeveloped areas. Would you not say that this would be probably the most effective means, especially in Asia, of dissipating this idea that America is solely associated with the military atom?

Mr. MURRAY. I believe so, Senator. I have been making public addresses that way since 1953 and 1952.

Senator JACKSON. Is it not a fact that the atom could be doing double duty, could be doing the work of the Voice of America and all of our agencies that are trying to inform the world of our peaceful intentions, and at the same time provide electric power to make it possible for nations to improve their economy?

Mr. MURRAY. I think we ought to make an all-out effort to do just what you have just said.

Senator JACKSON. We cannot minimize and we cannot separate the effect that this is going to have in dissipating the notion that we are only interested in using the military atom against Asiatic people; don't you think?

Mr. MURRAY. I think so.

Senator JACKSON. Is it not reasonable to assume that if we enter this program on a substantial basis that the Soviets cannot meet that challenge and at the same time carry on their heavy rearmament program?

Mr. MURRAY. I think there is no doubt that once we make up our minds in this business, that we can beat the Soviet, get out ahead of them and stay out ahead of them in this power field. I think our most fertile area is in the foreign areas.

Senator JACKSON. That is what I mean, if we can move in and provide electric power and take the lead, is it not reasonable to assume that the Soviets cannot meet that challenge effectively?

Mr. MURRAY. I just indicated in my opening remarks that they had very good capabilities, that is what I am worrying about, to make an all-out statement that they can't do this job.

Senator JACKSON. Mr. Murray, they have a power shortage at home in the Soviet Union even greater than ours. I question whether they can meet their power shortage and at the same time deliver on commitments and promises they might make to provide electric power reactors abroad. We have a greater industrial base, do we not?

Mr. MURRAY. We surely do.

Senator JACKSON. And they can do things in a certain given area just as effectively as we can, but they cannot do it in as many areas.

Mr. MURRAY. I think that is correct.

Senator JACKSON. Now what is the total appraised value that the Commission has placed on the allocation of both domestic and foreign uses of U 235? What was that, a billion dollars?

Senator JACKSON. In other words, there is the fuel. What is the plant capacity? What will the investment in electric plant power capacity amount to with that kind of investment in fuel?

Mr. MURRAY. Well, there are so many factors there involved I would like to have you give me overnight to figure that out.

Senator JACKSON. I mean a rough approximation. In other words, I don't think the whole story is told. We are given a story on the fuel cost which is a small part of the total cost.

Mr. MURRAY. Yes, but Senator, you must remember when we earmark and allocate 40,000 kilograms we do that over a period of, say, 20 years, the life of the amortization of a plant, so the person building the plant should be assured of his fuel supply over that period of years.

Senator JACKSON. You don't have any rough idea what it would amount to?

Mr. MURRAY. I have not.

Senator JACKSON. You don't have any general idea?

Mr. MURRAY. I haven't, Senator.

Senator JACKSON. The billion dollars represented in the fuel is the smallest factor of the investment that will have to be made.

Mr. MURRAY. I think that is correct.

Senator JACKSON. In other words, the reactors are going to cost many times more than the $1 billion represented in the 40,000 kilograms. I am trying to ask these questions because the public may not understand. If at the same time that they announced the billion dollars and 40,000 kilograms being made available, it would have been helpful had they indicated what the total investment would be because this is a staggering undertaking.

Representative PATTERSON. I would like to ask this one question. On this giveaway program in foreign countries, how do you propose to control the reactor so that plutonium won't be used in the weapons field?

Mr. MURRAY. That is a calculated risk, Mr. Patterson, that you must take.

Senator JACKSON. As I understand it, the present program contemplates it will be made available to friendly countries. We send arms to these friendly countries. It is all a calculated risk.

Representative PATTERSON. You would want some kind of control I am sure other than just a calculated risk.

Senator JACKSON. I just speak for myself on this. I think one must assume that there will be more than one country producing atomic fuel before long.

Representative PATTERSON. I don't think there will be very many countries building piles all over the world.

Senator JACKSON. What I am saying, Congressman, is that England is already producing fuel. There is agreement I think with the Dutch and the Norwegians. They are working on a production program. A number of countries will be producing fuel.

Representative PATTERSON. India at the present time is a friendly country. Would you recommend that a pile be built in India?

Senator JACKSON. Yes, I would recommend that a pile be built in India. I don't know of a better way in which to make it clear to the Asiatics that we want peace, and that we believe in peace. I don't know of anything that would be more devastating to the Communists than if we could say, "Yes, Mr. Khrushchev, and Mr. Bulganin came in here talking peace, saying that they are for the peaceful atom and they bragged about it. Yet when they bragged about it they exploded a hydrogen bomb in their own country, a test which the Indians opposed." Our friends over there would be able to tell the Indians, "It was America that was the first country to introduce the peaceful atom in your country." I think it would be the most effective story of our peaceful intentions that we could tell anywhere in the world. If we could say that it was America that was the first country to introduce the peaceful atom to help provide power for plants and homes and to make water available to an arid land, I think that is the kind of job we should be doing.

Representative PATTERSON. Then in a short time if they started to divert it, then what would the situation be?

Senator JACKSON. I don't want to get into the technology of the thing, but the fuel is made available when they are ready to start up. We could have our people supervise that and handle it. I would be willing to take that risk. If we don't get more friends in the world, we are going to be in desperate trouble.

Representative PATTERSON. Then you have lost control of the entire reactor. I was looking for information, that is all.

Senator JACKSON. We are only 7 percent of the world population. Being only 7 percent of the world population, we have to take calculated risks. They have 93 percent elsewhere. I think we need friends. When you are rich, powerful and strong, there is one thing you want to practice, and that is humility. I think our country has a golden opportunity to take the atom and to make it clear to the world that we want to use and energize the atom for the good of mankind. Unfortunately there has been too much effective Soviet propaganda, Mr. Chairman, that has been able to be put over to a lot of well intentioned but misled people, that America is nothing but a bunch of atomic warmongers. This is the kind of program that can dissipate that argument effectively.

I think the President is doing the right thing. I commend you, Mr. Murray. The only thing I will say is that I wish we had started this a little earlier. We might not have as much trouble in India. We could have started it a year ago without question. We have lost a year.

Chairman ANDERSON. Try to get these questions directed to Commissioner Murray while we have him here.

Representative PATTERSON. I was going to say to the Senator that I do not believe we can buy friendship. I think we can be respected if we are strong, and that respect will eventually lead to friendship. By any big program of giveaway in the atomic field as recommended here, I just can't see that we are going to accomplish a great deal.

Senator JACKSON. I am not suggesting that you buy friendship or that we can buy friends. I assume that the Congressman has voted for some of these foreign aid bills.

Representative PATTERSON. That is right, I have.

Senator JACKSON. I take it all of us realize when we vote foreign aid there is a calculated risk that that may not do the job that we would like it to do. On the other hand, I must say that without foreign aid we might have been left alone in the world. I would like to take that risk that we have taken in the past, and on balance I think we have come out well. I think the atomic program as advocated by Mr. Murray and by the President of the United States—the peaceful atom for export—will be a dramatic demonstration of our peaceful intentions and at the same time actually make a contribution in an area where the peaceful atom can go to work immediately on an economically feasible basis. This is one area where we can go to work and also help American industry to learn a lot about the reactor technology.

Representative PATTERSON. If you get down to American industry, you have to take into consideration too the competition that our industry has in the world today from foreign goods and by setting up these reactor plants all over the world, it will give us much more competition.

Mr. MURRAY. Mr. Hinshaw, would you allow me at this moment to read a little note I made this morning? It is a statement that Dr. Rabi made, I think within the last month. He is Chairman of our General Advisory Committee.

He says, "It" (meaning atomic power) "will not be cheap or cheaper than at present. The important thing is that it will be available at all.

We should conserve our coal for the important chemical uses for which it is almost indispensible."

Representative HINSHAW. Let us discuss that for a minute.

Mr. MURRAY. I bring that in because it is factors of that kind. I can tell you here that if tomorrow the cost of electric power in this country doubled, that would not stop the demand for electric power. You have to face the situation when there some day will be a shortage of power, that you must have atomic power and supply that shortage. If you have plenty of time to meet that shortage, then what we are doing is perfectly all right, you will be able to meet that shortage on a time schedule before power runs out in this country.

Representative HINSHAW. I think the Bureau of Mines statistics will show that the coal supply in this country will last about 500 to 1,000 years.

Mr. MURRAY. That is long enough.

Representative HINSHAW. There is no great hurry so far as I can see. That is coal alone. Then there are oil supplies for a few years. We keep putting off the fatal day on petroleum by finding new sources of supply. As a matter of fact, the reserves on petroleum even in spite of the fact that we are using them up at a much faster rate than before are increasing in terms of a number of years supply. Now they won't go on forever, I admit that, but certainly to build a reactor and expect it to operate at $3 or $4 million a year loss when it only cost $30 million in the first place, and then to think of carrying that along for a very long time, at that rate of loss, is ridiculous, is it not?

Mr. MURRAY. It is not. Mr. Hinshaw, I am glad you never had the decision on the Shippingport reactor. You would never have gone ahead.

Representative HINSHAW. I am glad to have participated in that. I say if you find another reactor running better there is no sense running it further.

Mr. MURRAY. There is not?

Representative HINSHAW. You might as well throw that out of the window.

Mr. MURRAY. There may be a lot of other factors why you would not do that. There are a lot of time schedules in meeting power and demand. If we are going to follow the attitude of the dog in the manger, that we have a lot of power in this country, and so on, and we have plenty of time, and we can take our time developing atomic power, you are absolutely correct.

Representative HINSHAW. What is your theory?

Mr. MURRAY. My theory is that we owe it to the rest of the world to do something about this and supply atomic power to the underprivileged countries.

Representative HINSHAW. Wouldn't we appear rather ridiculous if we put in a reactor in, say, India, a 100,000 kilowatts at 12 cents or 52 mills, whatever you want to figure, and then have the Russians come along and say, "We will save you the entire cost of that reactor each year by putting in one that only costs 6 mills." They would say, "The United States is crazy. They can't do it as well as we can."

Mr. MURRAY. That is a possibility.

Representative HINSHAW. It is a high probability at this point.

Mr. MURRAY. I don't thing it is a high probability at all.

Representative HINSHAW. The Russians claim that they have done everything before we have it, and done it better. There is no reason why they can't make that claim again.

Mr. MURRAY. I do not like to quote things that I have said myself, but here is September 21, 1954, a speech down at the CIO United Steel workers of America. I used the expression I just used:

> Our failure to go ahead on a broad vigorous program will be interpreted as a dog in the manger policy. It will be like saying we can have atomic electric power if we wanted it, but unlike the rest of the world we do not need it; therefore its development can wait for economic and financial forces to move it ahead.

Representative HINSHAW. I believe we offered in 1954, certainly in 1955, and at the Geneva Conference, to finance reactors in almost any part of the world, and it seems to me that the salesmen for reactors were all over the place in Geneva.

Mr. MURRAY. I heard that. I was not there.

Representative HINSHAW. There were several of them and the British were very active, too, in trying to sell reactors all over the world, and we didn't find any takers.

Now, if you want to give it away, that is easy enough. You can always give anything away that you have, even if it is given to the junkman.

Chairman ANDERSON. Mr. Murray, on this question of difference in cost per mills, the rough estimate on one of these large reactors which one of these groups of private companies is now building is a cost of about 12 mills. Mr. Hinshaw used figures of $8 million a year. Does that mean that $56 million a year is what they are going to have to add onto the bills of their people in order to keep this reactor running?

Mr. MURRAY. It does not seem but that there is something wrong with our mathematics here.

Chairman ANDERSON. I think probably what is going on is that these people are going to try to build one. As Mr. Hinshaw says, if the first part of the process does not work out, they will improve on it. Aren't the British going to build a number of reactors?

Mr. MURRAY. Yes.

Chairman ANDERSON. With capacity of 100,000 kilowatts.

Mr. MURRAY. Yes.

Chairman ANDERSON. Is Calder Hall finished?

Mr. MURRAY. Pretty near.

Chairman ANDERSON. What is its capacity? Maybe Mr. Davis can give it? Mr. Davis, what is the suggested capacity of Calder Hall?

Mr. DAVIS. They claim it has a capacity of 60,000 kilowatts or somewhat larger.

Chairman ANDERSON. The second one is around 100,000.

Mr. DAVIS. Successive units of the Calder Hall type will be the same. Their civilian power program reactors they will have built by 1960 or 1961 which were patterned after Calder Hall will be about 150,000 kilowatts.

Chairman ANDERSON. And there were six of them in the original program?

Mr. DAVIS. There were a total of about 20 in their whole program. It is actually 4 of these at the first stage with 150,000 kilowatts, but coming in operation only in 1960 or 1961 or later.

Chairman ANDERSON. In other words, the British hope to have 4 at 150,000 kilowatts. That is 600,000 kilowatts in Britain. With our somewhat limited resources would 200,000 kilowatts in the United States appear reasonable to you, Mr. Murray?

Mr. MURRAY. While you brought up the U. K. program, you must not forget that when the figure of 10 mills, I think has been used for the U. K. production, this question of cost of power, say, from a British reactor, is entirely dependent on what price they put on for plutonium. They can make that price in U. K. anything they want, depending on how valuable plutonium is to them in their future program.

Representative HINSHAW. That is true of the whole program.

Mr. MURRAY. Yes.

Representative HINSHAW. It depends on what price you want to pay for the plutonium.

Mr. MURRAY. That is right.

Representative HINSHAW. If you don't want to pay anything for the plutonium, the cost is naturally higher.

Mr. MURRAY. That is right. That is one of the reasons why I did my utmost to keep the price of byproduct plutonium in this country from reactors as low as possible, because if you don't, you will lose sight of the main objective here, that is, to get economic power.

Representative HINSHAW. Yes, sir, that is correct; and I would like to ask Dr. Davis how wrong my figures are. Has he been able to check them?

Mr. DAVIS. You have a decimal point wrong. It should be about one-tenth.

Representative HINSHAW. There is 8,760 million kilowatt-hours per year out of a 100,000-kilowatt reactor?

Mr. DAVIS. Yes, sir, if you operated a reactor at about 80 percent load factor, which is about the highest you could expect, then for each mill you would have about $700,000 per year difference.

Representative PRICE. Mr. Murray, I have been interested in the line of questioning directed to you as though you were attempting to justify your recommendation for acceleration of the power reactor program on the basis of economics. I don't see that anywhere in your statement.

Mr. MURRAY. I hope I have not given that impression. I tried to clear that up.

Representative PRICE. You did not give that impression to me, but some of the questions seem to indicate that that may be the case. I see in the statement no attempt on your part to justify the acceleration program on the basis of economics.

Mr. MURRAY. No, sir.

Representative PRICE. But you do indicate, I heard it said this morning when your first recommendation was reread, I think every member of the committee could agree with that recommendation, you said this:

> That we have adopted the policy which recognizes that the establishment of command lead in the atomic-power race is a matter of urgent importance to the United States.

Now, could you elaborate on why you think it is so important to our Nation to obtain and maintain a lead in the atomic-power race? What does it mean to the Nation and what does it mean to our industry, to American industry?

Mr. MURRAY. Well, answering the last part of your question first, what it means to American industry, it is pretty hard to guess. But it should mean a great deal to American industry. I cannot give you any of those answers in figures, but there is no question in my mind that the building, the exploitation of the atomic-power reactors throughout the world by American industry should be of great advantage to us. I think I have stated here this afternoon that my prime purpose it to get ahead, be sure we are ahead, and keep ahead of the Soviets. I have framed my whole statement on the basis there is an atomic-power race here, just like there was an atomic-arms race. Unless you recognize that, and recognize the importance of it and the value it is to the United States prestige, then my recommendations haven't very much weight. So that you make up your mind that there is need for power abroad at this time in many, many areas of the world, and you do what you can to alleviate that, and to supply that need. How far you go to supplying that need is a matter, of course, of public policy, and how urgent that need is, is also a matter of public policy. Your guess on that would be just as good as anyone else's.

As I said at the beginning of this statement, I do not think we can divorce this thing from the whole idea of what the world is facing in nuclear weapons and nuclear destruction.

Representative PRICE. Do you think our position in holding a lead in the atomic-power race is now threatened?

Mr. MURRAY. I don't question it is. I go on that assumption. My intelligence how far the Russians are along in their power reactors, I am not prepared to state here today, but I did state that at Geneva, you know, the Russian's team that was sent there was a very competent team. It was a team that was almost as good as our own. As I indicated, many people were at Geneva, and came back, and people who knew and should know told me that they thought their first string team was left home.

Now, I say if there is a race here, and the Soviet resources that they are willing to dump into this power program are used, then let private industry in this country meet that situation or we will lose out in this so-called atomic power race.

Chairman ANDERSON. Mr. Van Zandt.

Representative VAN ZANDT. Commissioner, does your statement here today represent your position as of a year ago, when the Commission was considering the program on which it recently reported to the Congress?

Mr. MURRAY. Mr. Van Zandt, a year ago you know there were great hopes and high hopes that once we changed the law, and the act, all things were going to be different and really what I was proposing in 1952 and 1953, all that would be changed, you would not need to worry that private industry would move in and take over. I think that we have had 12 months of experience with the new law, and the new act, and I think it has demonstrated very clearly that private industry won't, and it is no criticism of private industry, I don't think they can do this job if the job is as I have outlined.

Representative VAN ZANDT. I take your answer to mean that you had a program a year ago.

Mr. MURRAY. Yes, sir.

Representative VAN ZANDT. And that the Commission has accepted part of that program?

Mr. MURRAY. Yes, sir.

Representative VAN ZANDT. As of now, do they accept 50 percent of it, or 75 percent of it?

Mr. MURRAY. I think you must be referring to the power demonstration program.

Representative VAN ZANDT. Yes.

Mr. MURRAY. That is how we were going to get ahead and to explore these various avenues and approaches.

Representative VAN ZANDT. Have they accepted 50 percent or 75 percent of your thinking on the subject?

Mr. MURRAY. I think they accept the type of thinking. It is a matter of how do you get on with the job. You do not get on with the job in any business that I know of unless you set yourself a goal. You decide this is what has to be done, and this is your goal. Once you do that and you put a time schedule on that goal, then you move forward.

Representative VAN ZANDT. The program that is incorporated in the statement you have presented today, was this program rejected by your fellow members of the Commission? Or was it considered and laid aside, or what happened to it?

Mr. MURRAY. Well, I have to answer the question, I should say 6 months ago we had no foreign power program at all except research bilateral programs. The first indication I got of a change in attitude in the foreign power situation was the testimony before the McKinney panel, and I can recognize why, because the military has a part to play in this. Fissionable material has a part to play in the whole situation. So that we had no definite aggressive power program at all until almost up to a few months ago, and then things started to change. I want them changed more.

Representative VAN ZANDT. In your opinion then the delay in formulating and putting into effect a foreign program has been justified?

Mr. MURRAY. Delay?

Representative VAN ZANDT. Yes.

Mr. MURRAY. Yes, I think so. Maybe I should have been before you in 1954, stating that private industry would not do it. I predicted in speeches in 1953 that they would not, but they had not been given a real go-around, a real try at it.

Representative VAN ZANDT. Now you are advocating a step-up in the foreign program that has been put into effect?

Mr. MURRAY. And also the domestic program.

Representative VAN ZANDT. And also the domestic program?

Mr. MURRAY. Yes.

Representative VAN ZANDT. Did you advocate this to the fellow members of the Commission?

Mr. MURRAY. Yes.

Representative VAN ZANDT. And they turn it down?

Mr. MURRAY. Let me read you this. Perhaps I can get back to the statement about the foreign reactor programs if I can find it without too much delay. My first recommendation was back in 1954. I pushed as hard as I could for a foreign reactor in Japan. I just selected Japan because I thought that was one place in the world we might be thinking about, and there were objections raised to that, that it could not be done. So a study was made.

Representative VAN ZANDT. You have no complaint about the delay to your recommendations of 1954 because a moment ago in reply to my question, you said you felt that the delay was justified.

Mr. MURRAY. Well, maybe I had better backtrack here. I say I perhaps should have known better, or known that private industry from the experience I had in the past really would not step up to this program and, at that time, perhaps a year ago, I should have made the statements that I am making today. I did make them in effect.

Representative VAN ZANDT. Now, Commissioner, I am interested in the fact that this lukewarm program was announced and put into effect 6 months ago. I am also interested in the statement that you recommended a step-up in this program to the Commission, and the Commission did not go along with you. Now, let me ask you, when did you recommend to the Commission that the foreign program which was put into effect 6 months ago should be stepped up?

Mr. MURRAY. May I read from my statement:

In June 1955 I asked that the Commission consider adopting a definite goal for foreign power reactor construction and suggested a million kilowatts of nuclear power generating capacity within the next 5 to 6 years.

Representative VAN ZANDT. Now, Commissioner, this foreign program that you are talking about went into effect 6 months ago——

Mr. MURRAY. No, we have no foreign power program today. The program that am I visualizing, Mr. Van Zandt. We have a foreign program, but it is a program that is to give technical assistance and supply of fissionable material. That is our foreign program.

Representative VAN ZANDT. When was the first announcement made that fissionable material was available?

Mr. MURRAY. I think yesterday. Oh, we had allocated 100 and 200 kilograms about a year ago to the research bilateral program, but that was not the power program. You see, I distinguish here between the research program and power program.

Representative VAN ZANDT. Why did the Commission reject your recommendation? Do you know?

Mr. MURRAY. I would like them to speak for themselves. My guess is that somebody in higher authority had to make up their mind that fissionable material would be available.

Representative VAN ZANDT. Mr. Chairman, could we ask Commissioner Strauss?

Chairman ANDERSON. Yes, I was going to say when we would finish we would ask any member of the Commission to make a statement. I am perfectly willing, if you desire, to ask him to move up and direct questions to them.

Representative VAN ZANDT. I wish you would.

Chairman ANDERSON. I do think it ought to be with the approval of those individuals, because they did not expect to come here and testify on this. I appreciate very much the attendance of Chairman Strauss and the other members of the Commission. I do think it is somewhat difficult to bring them up and ask them a series of questions.

Mr. STRAUSS. Mr. Chairman, I would prefer, rather than to be questioned on a part of the testimony, to treat it as an entity. I saw this for the first time when I came into the room. It is rather too important I think to answer impromptu in that manner. I naturally will do so if pressed. I would prefer to delay comment.

Chairman ANDERSON. I think it would be better to do it at a subsequent date.

Representative HINSHAW. Mr. Chairman, I have returned now to my decimal point, and find I did displace one point in the amount of electricity that can be generated from a 100,000-kilowatt generator in a year. I find that instead of generating 8 billion kilowatts, it could generate 800 million kilowatts, which at 80 percent load factor would be approximately 700 million kilowatts, and hence the additional cost over conventional fuels and other forms of power, hydro power, is $700,000 per mill.

Now, I think we are in range of this point. If we have a difference in cost of 5 mills, then, of course, we have $3.5 million a year additional at which the reactor is going to provide power. At any such figure, say $3.5 million per year additional cost, as a businessman you would not say that was very economical, would you?

Mr. MURRAY. No, I think you are right about that.

Representative HINSLAW. Especially if the machine cost $30 million.

Mr. MURRAY. That is right.

Representative HINSHAW. In another few years you will have completely spent the $30 million in making up for losses in power, would you not?

Mr. MURRAY. That might be, yes, sir.

Representative HINSHAW. Therefore, if any such machine were in your plant, you would feel, and I think I would feel, too, that it would be better to replace it as quickly as we could, rather than take that loss every year, isn't that right?

Mr. MURRAY. Yes, that is why private industry is not in the business right now.

Representative HINSHAW. Exactly. Now, when the Government builds a plant like that, that is going to cost just 5 mills more, not 50 mills or 47 mills, and at the 47 mills, I figure the additional cost would be something like $32 million a year—I had better check my figures again, because I might be shy a decimal point—the idea would be that the Government itself should throw away the plant as soon as one more economical showed up on the horizon; would that not be so?

Mr. MURRAY. I don't think so. I think if I had the plant, I would keep it, would bring it in, train personnel, and do all sorts of things with it.

Representative HINSHAW. At $3.5 million loss a year on the plant?

Mr. MURRAY. Yes, in the immediate years ahead.

Representative HINSHAW. You would put Government money in that?

Mr. MURRAY. I think it would have other dividends than the one you are just indicating.

Representative HINSHAW. Could you not train them on a much smaller scale and reduce the plant loss figure somewhat?

Mr. MURRAY. You might, but we don't have many reactors around the country to train people these days. That is one of the reasons why we ought to have some more.

Representative HINSHAW. Don't you think the reactor program had better start out with putting reactors in the technical colleges, the small power reactors?

Mr. MURRAY. No, I would not be before you today if I thought that.

Representative HINSHAW. What do you think? Do you think we had better train them after they get out of the colleges?

Mr. MURRAY. No, I think it is a good idea to put reactors in college and train them. Any step forward is good.

Representative HINSHAW. Don't you think that is the primary step?

Mr. MURRAY. Well, it is a question of what you mean by primary step. There are a lot of primary steps you can take. Take a look at your naval reactor program. Look at the number of reactors you are going to have in that program to help train men to go on with the job. They have to train men to operate in the naval field, of course. We are going to learn a great deal through the naval reactor program. I don't want to give you a figure but you know what the first *Nautilus* reactor cost us to develop, and that is going to pay dividends in the industrial power field, great dividends, and it has.

Representative HINSHAW. We have a very great shortage at the present time of men capable of even operating such a plant.

Mr. MURRAY. I think the operation of plants like this, as Mr. Cole has indicated, you have to have competent people to operate these plants, but it is not the type of shortage that cannot be taken care of as fast as reactors are being built.

Representative HINSHAW. I offer you the pages of the New York Times of Sunday in which 4 or 5 and 6 pages of display advertising are in there just for the fine engineers and technicians and so forth to carry on our present program, and the shortage is very obvious, and it is very great.

Mr. MURRAY. I don't minimize that shortage at all, but what I am suggesting will help that shortage.

Representative HINSHAW. I would like to know how unless you give them some basic training. I cannot understand how you can increase the number of engineers and technicians available for this work without starting out in the high schools and colleges.

Chairman ANDERSON. Mr. Cole.

Representative COLE. I want to make certain I understand Mr. Murray's position vis-a-vis the Commission. In your statement you say in June 1955 you asked the Commission to consider adopting a definite goal for the foreign power reactor construction. Does that mean in June you requested the Commission directly to do that? I mean the proposition was submitted to the Commission?

Mr. MURRAY. Mr. Cole, I could find you 15 different places where I did this.

Representative COLE. I want to ask you what you mean by this statement, that is all. Do you mean you submitted to the Commission in June the suggestion that it adopt a definite goal for foreign power reactors?

Mr. MURRAY. With a million kilowatts, that is right.

Representative COLE. That was submitted to the Commission?

Mr. MURRAY. That is right.

Representative COLE. And then also in October you submitted to the Commission the proposition of a particular small power reactor abroad?

Mr. MURRAY. The State Department submitted it to us.

Representative COLE. Again referring to your statement, you say:

In October 1955, I urged the Commission without success to endorse without delay a specific proposal.

Mr. MURRAY. That is right, of the State Department.

Representative COLE. Your urging was directed to the Commission?

Mr. MURRAY. Yes, sir.

Representative COLE. And not in some speech out some place? That is what I am getting at.

Mr. MURRAY. That is right.

Representative COLE. Your thinking on this subject was presented to this Commission?

Mr. MURRAY. It was presented to the Commission.

Representative COLE. Now, has this proposal which is now indicated today with respect to what you might call the 10-year program, has that been submitted to the Commission?

Mr. MURRAY. Not formally, no.

Representative COLE. When we started out the hearings the question of whether you dissented from the Commission's report or not was discussed. I take it, and I simply want to understand your position in fairness to you, that you do not dissent from the Commission's report?

Mr. MURRAY. I dissent with a lot of statements in that 275 pages of literature, certainly. I did not intend to go through 275 pages to tell you where I dissented.

Representative COLE. I would very much like to have your dissents. What part of the report you disagree with.

Mr. MURRAY. I disagreed with statements about strontium. I did not know too much about, but I did not want to make such broad statements about contamination or things like that. I will document these things for you, Mr. Cole, but I tell you I did not read the 275 pages. I looked at it. I said to my fellow Commissioners, "Now, look, I am not going to read 275 pages and put my John Henry in this document and say there it is, I agree with every statement in that document."

Representative COLE. You say you have not read the document. How can you say you disagreed with some parts?

Mr. MURRAY. Because I know the document has been made up over the years and statements—maybe I have an intuition, but if you want me to document the various statements, I will be very glad to do it.

Representative COLE. I would think that what you are saying is your intuition causes you to dissent with anything that the Commission has prepared.

Mr. MURRAY. No, I think you are going a step too far.

Chairman ANDERSON. Do you request that he submit a list of what he dissents to in the report?

Representative COLE. I am not trying to be unfair to you. When you say perhaps, using your own words, you say, "Perhaps I have an intuition to dissent," what you mean is that through your experience in dealing with the Commission, your experience has been to disagree with what——

Mr. MURRAY. I don't think I have to read the power reactor program and all the statements in that in order to know what the problems are all about.

Representative COLE. When you say you dissent with the report——

Mr. MURRAY. I did not say—remember, at the beginning of this hearing you questioned that word "dissent"—I did not say I dissented. I said I did not adopt all.

Representative COLE. That is what I thought was your attitude, not that you disagreed with the report, but that you did not necessarily approve it.

Mr. MURRAY. That is right, and I wanted flexibility to come before you today and say what I did say today, and not refer back to 275 pages, and say this is not in accordance with what was in the 275 pages.

Representative COLE. That is what I understood originally to be your position. Now, do you mean that you do not necessarily disagree with the report that was submitted by the four members of the Commission?

Mr. MURRAY. Surely, as I have indicated in my statement here, I don't intend to adopt the economic situation that has pervaded the whole report. I tried to make that as clear as I could.

Representative COLE. What I am trying to find out, Mr. Murray, is to what extent, if at all, you disagree with the Commission's report, understanding as I do that you do not adopt the Commission's report.

Mr. MURRAY. I don't adopt the Commission's report in its entirety. I think I am directing my attention specifically to the power reactor part of the report. I have no other criticism at this time to offer to any other part of the report.

Representative COLE. Fine. I will let it go at that.

Chairman ANDERSON. Are there other questions? If not, thank you, Mr. Murray, for your appearance this afternoon.

(Thereupon at 4 p. m., Thursday, February 23, 1956, the committee recessed until Wednesday, February 29, 1956.)

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